Version with Markings to Show Changes Made

DESCRIPTION

~~PROGRAM SELECTION AND EXECUTION DEVICE,~~ DATA SELECTION AND EXECUTION DEVICE~~, IMAGE DISPLAY DEVICE, AND CHANNEL SELECTION DEVICE~~ IMAGE

TECHNICAL FIELD

The present invention relates to a program selection and execution device and a data selection and execution device which select and execute a program and data respectively in a personal computer or the like, and also to an image display device and a channel selection device which receive a television broadcast or the like and select a channel in accordance with a program guide display. More particularly, the invention relates to a program selection and execution device and a data selection and execution device, and also an image display device and a channel selection device which can realize an operation environment which is intuitive and familiar for a user when performing a selection operation.

BACKGROUND ART

In a conventional two-dimensional interface as represented by Windows (Registered Trademark by Microsoft Co., Ltd.) or the like, ~~as a method~~ for selecting and executing a program or data, a method is employed ~~is one~~ which comprises selecting one among

a plurality of items by a pointing device such as a mouse, ~~which~~ such items ~~are~~ being displayed in parallel on a two-dimensional display as in a menu. In this method, however when the number of objects to be selected increases, some of the objects would not be displayed within the display area, and therefore, when an object to be selected is not displayed within the display area, it is ~~needed~~ necessary for the user to make the item be displayed within the display area by performing an operation such as a scroll of the display area, and to select the item by a pointing device such as a mouse.

Further, with the advance of multi-channel digitalization today, plural programs are received via broadcast or a ~~network performs~~network, and program guiding is performed by broadcasting of promotion channels in a multi-screen display ~~as another type~~.

A conventional multi-screen display employs a method of dividing the display screen into rectangular regions and allocating respective images or channels to respective divided areas for display. In order to select an image or a channel from this multi-screen display, a cursor display or a selection frame display is initially performed to show a user that it is a selectable image or channel. Then the user moves a cursor or a selection frame employing an input device such as a cross button or a mouse, and pushes a button of selection and decision when the cursor or the selection frame corresponds to

an image or a channel to be selected, thereby to select the image or the channel. The selected image or channel is displayed or a full-screen display switched from a multi-screen display.

However, while a conventional program selection and execution device or data selection and execution device employing a menu display in a two-dimensional interface is easy for a user familiar with operations of a personal computer or the like to operate, it is difficult for a user unfamiliar with operations of a personal computer to ~~understand, the~~understand the operation intuitively, and it may make him or her bewildered by their operations.

Further, a conventional multi-screen display employs a display method of dividing a display screen into rectangles, and has a problem in that as the division number increases, a display size for an image is reduced, which causes a user to have difficulty in seeing an image and selecting a channel. There is also a problem in that since operation steps such as cursor movements are performed when a channel or an image is selected, operations of a selection and decision button become complicated as the number of display screens increases.

Therefore, as selection items become complex, a selection of a program or data seen in a personal computer as well as a selection of a program in broadcast or network become complicated for a user to operate, resulting in a common

problem that a selection in a short time is impossible and a malfunction easily occurs.

The present invention is made to solve the above-mentioned problems and has for its object to provide a program selection and execution device and a data selection and execution device as well as an image display device and a channel selection device which can realize an intuitive operation environment familiar to a user for a program or data in a personal computer as well as images composed of multi-screen in broadcast.

~~DISCLOSURE~~ SUMMARY OF THE INVENTION

According to a first aspect of this invention ~~(Claim 3)~~, there is provided a program selection executing device which comprises: a selecting object displaying means for displaying an image on a display screen, which image comprises a selecting object having mapped textures indicating program contents to respective planes of a three-dimensional rotation body object, which plural planes being disposed at regular intervals with respect to a center axis, being located in a three-dimensional virtual space; a rotation display control means for giving a rotation display control signal to display an image which comprises the selecting object rotating with the center axis as a center of rotation in the three-dimensional virtual space, to the selecting object displaying means; a selection input means for receiving a selection input to select a program; a

selection plane judging means for judging which plane among the plural planes composing the three-dimensional rotation body object faces front on a display screen when the selection input is inputted from the selection input means; a correspondence table holding means for holding information which indicates a correspondence relationship between the plural planes composing the three-dimensional rotation body object and the programs; a program deciding means for judging the program which corresponds to the plane judged by the selection plane judging means based on the information held in the correspondence table holding means, so as to decide a program to execute; a program executing means for executing the program decided by the program deciding means; and the rotation display control means being provided with a holding means for holding information to rotate the selecting object in a prescribed pattern, and providing the rotation display control signal to the selecting object displaying means on the basis of the information held in the holding means.

In the program selection and execution device of this configuration, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer. Further,

since the three-dimensional rotation body object automatically rotates, the user is only required to be concerned of a program selection, thereby further simplifying the operation.

According to a second aspect of this invention ~~(Claim 5)~~, in the program selection and execution device defined in ~~Claim 3~~ the first aspect, a counter means is provided, which counts the number of times when the plane which faces front, among the plural planes composing the three-dimensional rotation body object, is switched while the selecting object is rotating on the display screen, to output count information, and the selection plane judging means judges the surface which faces front on the display screen in accordance with the counting information outputted by the counter.

In the program selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a third aspect of this invention ~~(Claim 6)~~, in the program selection and execution device defined in ~~Claim 3~~the first aspect, the selection plane judging means judges a plane which faces front on the basis of depth information which is obtained when the selecting object display means displays

the selecting object on a display screen.

In the program selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a fourth aspect of this invention ~~(Claim 7)~~, in the program selection and execution device defined in ~~Claim 3~~the first aspect, the selection plane judging means judges the plane which faces front on the display screen in accordance with rotation the angle information which indicates an angle by which the selecting object has rotated from an initial state.

In the program selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a fifth aspect of this invention ~~(Claim 8)~~, in the program selection and execution device defined in ~~Claim 3~~the first aspect, a screen display switching means is provided, which switches a screen display so that the execution display

screen is displayed at the program execution when a selected program has an execution display screen.

In the program selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and further, the execution screen of the selected program is displayed to enable an easy recognition of the selection, whereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a sixth aspect of this invention ~~(Claim 11)~~, there is provided a data selection and execution device which comprises: a selecting object displaying means for displaying an image on a display screen, which image comprises a selecting object having mapped textures indicating program contents to respective planes of a three-dimensional rotation body object, which plural planes being disposed at regular intervals with respect to a center axis, being located in a three-dimensional virtual space; a rotation display control means for giving a rotation display control signal to display an image which comprises the selecting object rotating with the center axis as a center of rotation in the three-dimensional virtual space, to the selecting object displaying means; a selection input means for receiving a selection input to select a program; a

selection plane judging means for judging which plane among the plural planes composing the three-dimensional rotation body object faces front on a display screen when the selection input is inputted from the selection input means; a first correspondence table holding means for holding information which indicates a correspondence relationship between the plural planes composing the three-dimensional rotation body object and the programs; a data deciding means for judging the data which corresponds to the plane judged by the selection plane judging means based on the information held in the first correspondence table holding means, so as to decide a data to open; a second corresponding table holding means for holding information which indicates a corresponding information between the data and the program to open the data; a program deciding means for judging the program to open the data which is decided by the data deciding means based on the information held in the second correspondence table holding means, so as to decide a program to execute; a program executing means for executing the program decided by the program deciding means, so as to open the data decided by the data deciding means; and the rotation display control means being provided with a holding means for holding information to rotate the selecting object in a prescribed pattern, and providing the rotation display control signal to the selecting object display means in accordance with the information held in the holding means.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a seventh aspect of this invention ~~(Claim 13)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, a counter means is provided, which counts the number of times when the plane which faces front, among the plural planes composing the three-dimensional rotation body object, is switched while the selecting object is rotation on the display screen, to output count information, and the selection plane judging means judges the plane which faces front on the display screen in accordance with the counting information outputted by the counter.

In the data selection and execution device of this

configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to an eighth aspect of this invention ~~(Claim 14)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, the selection plane judging means judges the plane which faces front on the basis of depth information which is obtained when the selecting object display means displays the selecting object on a display screen.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a ninth aspect of this invention ~~(Claim 15)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, the selection plane judging means judges the plane which faces front on the display screen in accordance with rotation the angle information which indicates an angle by which the selecting object has rotated from an initial state.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a tenth aspect of this invention ~~(Claim 16)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, a screen display switching means is provided, which switches a screen display so that the execution display screen is displayed at the program execution when a program to be executed has an execution display screen.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to an eleventh aspect of this invention ~~(Claim 17)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, the selecting object displaying means maps, when data corresponding to each plane of the three-dimensional rotation body object are moving image data, an

image obtained by reproducing the moving image data to a corresponding plane as a texture.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and it is possible to easily judge which plane can be selected at a timing from whether the image mapped to the plane is moving or not. Thereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a twelfth aspect of this invention ~~(Claim 18)~~, in the data selection and execution device defined in ~~Claim 17~~the eleventh aspect, the selecting object display means maps a moving image obtained by reproducing moving image data to a corresponding plane which faces front on a display screen among plural planes composing the three-dimensional rotation body object as a texture, while maps still pictures extracted from the moving image obtained by reproducing the moving image data to corresponding planes which do not faces front on the display screen among plural planes composing the three-dimensional rotation body object as textures.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of

rolling a cylindrical rotation body in the actual world can be made associated, and it is easily possible to judge which plane can be selected at a timing from whether the image mapped to the plane is moving or not. ~~Thereby it~~Thereby, it is possible to realize an intuitive operation environment being familiar even to a user who is unfamiliar with a personal computer.

According to a thirteenth aspect of this invention ~~(Claim 19)~~, in the data selection and execution device defined in ~~Claim 11~~the sixth aspect, said data selection and execution device is provided with a data reproducing and displaying means, which performs reproduction and display of corresponding data in conjunction with display of the selecting object when data corresponding to respective planes of the three-dimensional rotation body object are sound data and moving image data accompanying sound data, and said data reproducing and displaying means performs reproduction and display so that, when the plane which faces front the most on the display screen switches from a first plane to a second plane adjacent the first plane by the rotation of the selecting object, the sound data fades out the reproduction and display of data corresponding to the first surface, while fades in the reproduction and display of data corresponding to the second surface.

In the data selection and execution device of this configuration, by employing a three-dimensional rotation body

object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, whereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer. Further, since music data or moving image data which are auxiliary displayed with the selecting object are displayed continuously, a data selection and execution device in which a user can perform data selection comfortably is provided.

According to a fourteenth aspect of this invention ~~(Claim 20)~~, in the data selection and execution device defined in Claim 11, a data reproducing-displaying means is provided, which performs reproduction and display of corresponding data in conjunction with a display of the selecting object when data corresponding to each surface of the three-dimensional rotation body object are data including sound data, and which has the sound source position of sound data corresponding to a first surface, which is a surface turned forward most on the display screen, and the sound source position of sound data corresponding to a second surface adjacent to the first surface by the rotation of the selecting object, and performs reproduction and display of the first and second sound data in conjunction with the positional movement of the first and second surfaces on the screen display.

In the data selection and execution device of this

configuration, by employing a three-dimensional rotation body object in a three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, whereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer. Further, since music data or moving image data which are auxiliary display with the selecting object are displayed continuously, a data selection and execution device in which a user can perform data selection comfortably is provided.

According to a fifteenth aspect of this invention ~~(Claim 21)~~, there is provided an image display device which comprises: an image receiving means for receiving an input signal transmitted via broadcast or a network and outputting an input image signal; a memory means for holding the input image signal; a memory input/output control means for writing the input image signal to the memory means, outputting a memory control signal to the memory means in accordance with an area cut-out information indicating a position when an area employed as a texture is cut out from the input image signal, and reading a partial image signal from the memory means; a parameter separating means for separating parameter information, comprising three-dimensional coordinate information and the area cut-out information into the area cut-out information and the three-dimensional coordinate information, and outputting

the area cut-out information to the memory input/output control means while outputting the three-dimensional coordinate information to an object position deciding means; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information and outputting object coordinate information of the three-dimensional object in the three-dimensional virtual space; a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming it to display projection plane coordinate information; a rasterizing means for mapping the partial image signal to a prescribed plane of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting a three-dimensional image signal; a frame memory means for holding the three-dimensional image signal and outputting an output image signal at a prescribed timing; and an image display means for displaying the output image signal.

In the image display device of this configuration, a prescribed area is cut out from a transmitted and inputted image signal and this is mapped to a plane of the object in the three-dimensional virtual space, whereby a three-dimensional display of an image can be realized, enabling a visually clear image display.

According to a sixteenth aspect of this invention ~~(Claim 22)~~, in the image display device defined in ~~Claim 21~~the fifteenth aspect, the parameter information inputted from the parameter separating means varies time sequentially.

In the image display device of this configuration, the three-dimensional rotation body object displayed in the three-dimensional virtual space can have an effect of animation, thereby enabling a visually clear image display.

According to a seventeenth aspect of this invention ~~(Claim 24)~~, there is provided an image display device which comprises: an image receiving means for receiving an input signal which is transmitted via broadcast or a network and comprises a prescribed number of partial images, and outputting an input image signal; a memory means for holding the input image signal; a memory input/output control means for writing the input image signal to the memory means, and outputting a memory control signal to the memory means on the basis of an area cut-out information which indicates a position while cutting out an area employed as a texture from the input image signal and corresponds to a prescribed number of partial images, and reading partial image signals from the memory means; a parameter separating means for separating parameter information, comprising three-dimensional coordinate information corresponding to the prescribed number of partial images and the area cut-out information into the area cut-out information

and the three-dimensional coordinate information on the basis of the parameter output control information, and outputting the area cut-out information to the memory input/output control means, while outputting the three-dimensional coordinate information to an object position deciding means; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information and outputting an object coordinate information of the three-dimensional object in the three-dimensional virtual space; a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming the same to a display projection plane coordinate information; a rasterizing means for outputting the parameter output control information to the parameter separating means for the number of times corresponding to the prescribed number of partial images while mapping the partial image signal to a prescribed plane of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting three-dimensional image signals; a frame memory means for holding the three-dimensional image signals and outputting the output mage signals at prescribed timings; and an image display means for displaying the output image signal.

In the image display device of this configuration, areas

are cut out along the division boundaries of the multi-screen from the image signal transmitted as a multi-screen and there are mapped to the object planes in the three-dimensional virtual space, whereby the three-dimensional display of plural images can be realized, thereby enabling a visually simple image display.

According to an eighteenth aspect of this invention ~~(Claim 25)~~, in the image display device defined in ~~Claim 24~~the seventeenth aspect, the parameter information inputted by the parameter separating means varies time sequentially.

In the image display device of this configuration, the three-dimensional rotation body object displayed in the three-dimensional virtual space can have an effect of animation, thereby enabling a visually clear image display.

According to a nineteenth aspect of this invention ~~(Claim 27)~~, there is provided an image display device which comprises: an image receiving means for receiving an input signal which is transmitted via broadcast or a network and comprises a prescribed number of partial images, and outputting an input image signal; an area separating means for separating an area from the input image signal on the basis of an area cut-out information which indicates a position while cutting out an area employed as a texture from the input image signal and corresponds to a prescribed number of partial images, and outputting an image signal to be stored in a memory; a memory

means for holding the image signal to be stored in a memory; a memory input/output control means for writing the image signal to be stored in a memory to the memory means, outputting a memory control signal to the memory means on the basis of an area cut-out information, and reading a partial image signal from the memory means; a parameter separating means for separating parameter information comprising three-dimensional coordinate information corresponding to the prescribed number of partial images and the area cut-out information, into the area cut-out information and the three-dimensional coordinate information, and outputting the area cut-out information to the memory input/output control means while outputting the three-dimensional coordinate information to an object position deciding means on the basis of parameter output control information; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information and outputting the object coordinate information of the three-dimensional object in the three-dimensional virtual space; a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming the same to display projection plane coordinate information; a rasterizing means for outputting the parameter output control information to the parameter separating means for the number of times

corresponding to the prescribed number of partial images while mapping the partial image signal to a prescribed plane of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting a three-dimensional image signals; a frame memory means for holding the three-dimensional image signals and outputting the output image signals at prescribed timings; and an image display means for displaying the output image signal.

In the image display device of this configuration, when areas are cut out from the image and are mapped to object planes in the three-dimensional virtual space, not the whole image but only the cut-out areas are held in the memory, thereby the memory amount is reduced.

According to a twentieth aspect of this invention ~~(Claim 28)~~, there is provided an image display device which comprises: an image receiving means for receiving an input signal which is transmitted via broadcast or a network and comprises a prescribed number of partial images, and outputting an input image signal; a memory means for holding the input image signal; a memory input/output control means for writing the input image signal to the memory means, and outputting a memory control signal to the memory means on the basis of an area cut-out information indicating a position while cutting out an area employed as a texture from the input image signal, and reading partial image signals from the memory means; an image analyzing

means for judging the prescribed number from the input image signal and outputting an area number information; a parameter generating means for generating parameter information comprising three-dimensional coordinate information and the area cut-out information on the basis of the area number information, and outputting the area cut-out information to the memory input/output control means while outputting the three-dimensional coordinate information to an object position deciding means on the basis of parameter output control information; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information and outputting object coordinate information of the three-dimensional object in the three-dimensional virtual space; a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming the same to display projection plane coordinate information; a rasterizing means for outputting the parameter output control information to the parameter generating means for the number of times corresponding to the prescribed number of partial images while mapping the partial image signals to prescribed surfaces of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting three-dimensional image signals; a frame memory means for holding the

three-dimensional image signals and outputting output image signals at prescribed timings; and an image display means for displaying the output image signals.

In the image display device of this configuration, the division number of an image transmitted on a multi-screen is recognized after reception, and the shape information of the three-dimensional object is automatically generated in accordance with the division number, thereby realizing correspondence to an image comprising plural kinds of multi-screens.

According to a twenty-first aspect of this invention ~~(Claim 29)~~, there is provided an image display device which comprises: an image receiving means for selectively receiving an input signal which is transmitted via broadcast or a network and comprises a prescribed number of partial images based on channel information, and outputting the input image signal; a memory means for holding the input image signal; a memory input/output control means for writing the input image signal to the memory means, outputting a memory control signal to the memory means on the basis of an area cut-out information which indicates a position while cutting out an area employed as a texture from the input image signal and corresponds to a prescribed number of partial images, and reading partial image signals from the memory means; a parameter separating means for separating parameter information, comprising three-dimensional

coordinate information corresponding to the prescribed number of partial images, the area cut-out information, and channel correspondence information indicating correspondence between an object and a channel, into the area cut-out information and the three-dimensional coordinate information on the basis of parameter output control information, and outputting the area cut-out information to the memory input/output control means, outputting the three-dimensional coordinate information to an object position deciding means, while outputting the channel correspondence information to a channel deciding means; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information, and outputting object coordinate information of the three-dimensional object in the three-dimensional virtual space, while outputting object allocation order information on the basis of the object coordinate information on the basis of user's input; an object position comparing means for comparing positions of respective objects with reference to the object allocation order information and outputting selected object information having selected an object on a prescribed condition to the channel deciding means; a channel deciding means for deciding a channel that corresponds to the selected object on the basis of the selection object information and the channel correspondence information, and outputting channel information;

a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming the same to display projection plane coordinate information; a rasterizing means for outputting the parameter output control information to the parameter separating means for the number of times corresponding to the prescribed number of partial images while texture mapping the partial image signals to prescribed planes of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting the three-dimensional image signal; a frame memory means for holding the three-dimensional image signals and outputting an output image signal at a prescribed timing; and an image display means for displaying the output image signal and the input image signal outputted from the image receiving means with switching the two.

In the image display device of this configuration, partial images of the input image constituted on a multi-screen are cut out, these are mapped to respective planes of the object in the three-dimensional virtual space as textures, and the three-dimensional object is moved, thereby performing an animation display. Further, by switching the display to a full-screen display of a channel which corresponds to the plane that is displayed at a position closet to the view point in the three-dimensional virtual space when a user pushes a selection button,

it is possible to realize a channel selection.

According to a twenty-second aspect of this invention ~~(Claim 30)~~, in the image display device defined in ~~Claim 29~~the twenty-first aspect, the object position deciding means selects a plane which is closest to the view point.

In the image display device of this configuration, employing the three-dimensional rotation body object in the three-dimensional virtual space, it is possible to realize a channel selection by switching the display to a full-screen display of a channel which corresponds to the plane that is displayed at a position closest to the view point in the three-dimensional virtual space when a user pushes a selection button.

According to a twenty-third aspect of this invention ~~(Claim 31)~~, there is provided an image display device which comprises: a first image receiving means for receiving a first input signal transmitted via broadcast or a network and outputting a first input image signal comprising a prescribed number of partial images; a second image receiving means for selectively receiving a second input signal transmitted via broadcast or a network based on channel information and outputting a second input image signal; a memory means for holding the first input image signal; a memory input/output control means for writing the first input image signal to the memory means, outputting a memory control signal to the memory means on the basis of an area cut-out information which

indicates a position while cutting out an area employed as a texture from the input image signal and corresponds to a prescribed number of partial images, and reading partial image signals from the memory means; a parameter separating means for separating parameter information comprising three-dimensional coordinate information corresponding to the prescribed number of partial images, the area cut-out information, and channel correspondence information indicating correspondence between an object and a channel, into the area cut-out information and the three-dimensional coordinate information on the basis of parameter output control information, and outputting the area cut-out information to the memory input/output control means, outputting the three-dimensional coordinate information to an object position deciding means, while outputting the channel correspondence information to a channel deciding means; an object position deciding means for disposing a three-dimensional object in a three-dimensional virtual space on the basis of the three-dimensional coordinate information, and outputting object coordinate information of the three-dimensional object in the three-dimensional virtual space, while outputting object allocation order information on the basis of the object coordinate information according to user's input; an object position comparing means for comparing positions of respective objects with reference to the object allocation order information and outputting selected object

information having selected an object on a prescribed condition to the channel deciding means; a channel deciding means for deciding a channel that corresponds to the selected object on the basis of the selected object information and the channel correspondence information and outputting the channel information; a perspective projection transformation means for performing perspective projection of the object coordinate information onto a display projection plane and transforming the same to display projection plane coordinate information; a rasterizing means for outputting the parameter output control information to the parameter separating means for the number of times corresponding to the prescribed number of partial images, while texture mapping the partial image signals to prescribed planes of the three-dimensional object on the basis of the projection plane coordinate information, and generating and outputting three-dimensional image signals; a frame memory means for holding the three-dimensional image signal and outputting a three-dimensional output image signal at a prescribed timing; an enlargement deformation means for subjecting the partial image signal to enlargement deformation processing to output an partially enlarged and deformed image signal; an image switching means for switching the three-dimensional output image signal and the partially enlarged and deformed image signal at a prescribed timing to output an output image signal; and an image display means for displaying

the output image signal and the second input image signal with switching the two.

In the image display device of this configuration, when performing to a full-screen display of the selected channel, by subjecting the partial image that is employed as a texture while performing the three-dimensional display, to enlargement-deformation processing and display, and thereafter, performing switching to a full-screen display, it is possible to realize a smooth image switching.

According to a twenty-fourth aspect of this invention ~~(Claim 32)~~, there is provided a channel selection device which comprises: an image receiving means for receiving an input signal transmitted via broadcast or a network, selecting a channel based on selection channel information outputted from a channel deciding means, and outputting an input image signal; a memory means for holding the input image signal; a memory input/output control means for writing the input image signal to the memory means, and outputting a memory control signal to the memory means and reading partial image signals from the memory means on the basis of area cut-out information inputted from a correspondence table holding means; a selecting object display means for displaying an image on a display screen, which image comprises a selecting object being disposed in a three-dimensional virtual space, which selecting object comprises partial images selected that indicate channel

contents being mapped as textures to respective planes of a three-dimensional rotation body object, the plural respective planes of which are disposed at regular intervals with respect to a central axis; a rotation display control means for giving a rotation display control signal to display an image in which the selecting object is rotated with the central axis as a center of rotation in the three-dimensional virtual space; a selection input means for receiving a selection input to select a program; a selection plane judging means for judging which plane among the plural planes composing the three-dimensional rotation body object faces front on a display screen when a selection input is inputted from the selection input means; a correspondence table holding means for holding information which indicates a correspondence relationship between plural planes composing the three-dimensional rotation body object, texture information of partial images corresponding to respective channels, and area cut-out information for generating the partial images corresponding to respective channels based on area information parameter outputted externally; and a channel deciding means for judging what channel corresponds to the plane judged by the selection plane judging means on the basis of the information held in the correspondence table holding means, deciding a channel to be displayed with switching, and outputting selected channel information to the image receiving means.

In the channel selection device of this configuration, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

According to a twenty-fifth aspect of this invention ~~(Claim 33)~~, in the channel selection device defined in ~~Claim 32~~the twenty-fourth aspect, there is provided a parameter separating means which separates an area parameter from the input signal when the area information parameter is inputted with multiplexed in the input signal.

In the channel selection device of this configuration, an input signal such as broadcast and the area information parameter can be received and separated at a location.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure ~~1(a)~~1 is a block diagram illustrating the configuration of a program selection and execution device according to a first embodiment of the present invention.

~~Figure 2 is a diagram~~ Figures 2(a) and 2(b) are diagrams exemplifying a three-dimensional rotation body object disposed in a three-dimensional virtual space in a program selection and execution device, a data selection and execution device, as

well as an image display device, and a channel selection device according to the present invention.

Figure 3 is a diagram exemplifying a correspondence table held by a correspondence table holding means of the program selection and execution device according to the first embodiment.

Figure 4 is a block diagram illustrating the configuration of a program selection and execution device according to a second embodiment of the present invention.

Figure 5 is a block diagram illustrating the configuration of a program selection and execution device according to a third embodiment of the present invention.

Figure 6 is a block diagram illustrating the configuration of a program selection and execution device according to a fourth embodiment of the present invention.

~~Figure 7 is a diagram~~Figures 7(a) and 7(b) are diagrams exemplifying a judgement of a front plane in the program selection and execution device according to the fourth embodiment.

Figure 8 is a block diagram illustrating the configuration of a program selection and execution device according to a fifth embodiment of the present invention.

Figure 9 is a block diagram illustrating the configuration of a data selection and execution device according to a sixth embodiment of the present invention.

Figure 10 is a diagram exemplifying a correspondence table held by a correspondence table holding means of a data selection and execution device according to the sixth embodiment.

Figure 11 is a diagram exemplifying a screen display of the data selection and execution device according to the sixth embodiment.

Figure 12 is a block diagram illustrating the configuration of a data selection and execution device according to a seventh embodiment of the present invention.

Figure 13 is a block diagram illustrating the configuration of a data selection and execution device according to an eighth embodiment of the present invention.

~~Figure 14 is a diagram~~Figures 14(a)-14(c) are diagrams for explaining the operation of the data selection and execution device according to the eighth embodiment.

~~Figure 15 is a diagram~~Figures 15(a)-15(c) are diagrams for explaining the operation of the data selection and execution device according to the eighth embodiment.

~~Figure 16 is a diagram~~Figures 16(a)-16(c) are diagrams for explaining the operation of the data selection and execution device according to the eighth embodiment.

~~Figure 17 is a diagram~~Figures 17(a)-17(c) are diagrams for explaining the operation of the data selection and execution device according to the eighth embodiment.

Figure 18 is a block diagram illustrating the configuration of an image display device according to a ninth embodiment of the present invention.

Figure 19 is a conceptual diagram exemplifying a three-dimensional display according to the ninth embodiment.

~~Figure 20 is a~~Figures 20(a) and 20(b) are schematic ~~diagram~~ diagrams exemplifying information required for the three-dimensional display according to the ninth embodiment.

Figure 21 is a schematic diagram exemplifying a channel selection method according to the ninth embodiment.

~~Figure 22 is a~~Figures 22(a) and 22(b) are schematic ~~diagram~~ diagrams exemplifying a judgmental criteria of a channel selection according to the ninth embodiment.

Figure 23 is a schematic diagram exemplifying a difference between a perspective projection transformation and an affine transformation according to the ninth embodiment.

Figure 24 is a block diagram illustrating the configuration of an image display device according to a tenth embodiment of the present invention.

Figure 25 is a schematic diagram exemplifying a memory storage of a partial image according to the tenth embodiment.

Figure 26 is a block diagram illustrating the configuration of an image display device according to an eleventh embodiment of the present invention.

~~Figure 27 is a~~Figures 27(a)-27(d) are schematic ~~diagram~~

diagrams exemplifying a generation of three-dimensional information according to the eleventh embodiment.

Figure 28 is a block diagram illustrating the configuration of an image display device according to a twelfth embodiment of the present invention.

Figure 29 is a schematic diagram regarding an image switching method according to the ninth to eleventh embodiments.

Figure 30 is a schematic diagram regarding an image switching method according to the twelfth embodiment.

Figure 31 is a block diagram illustrating the configuration of an channel selection device according to a thirteenth embodiment of the present invention.

Figure 32 is a diagram exemplifying a correspondence table held by a correspondence table holding means of the channel selection device according to the thirteenth embodiment.

Figure 33 is a diagram regarding information required for a three-dimensional display according to the thirteenth embodiment.

~~BEST MODE TO EXECUTE~~DETAILED DESCRIPTION OF THE INVENTION

(Embodiment 1)

Figure 1 is a block diagram illustrating the configuration of a program selection and execution device according to a first embodiment of the present invention.

In figure 1, numeral 101 denotes a rotation instruction

input means which inputs an instruction to rotate a three-dimensional rotation body object in a three-dimensional virtual space, numeral 102 denotes a parameter holding means which holds parameters to rotate the three-dimensional rotation body object, and numeral 103 denotes a parameter changing means which reads parameters before being modified from the parameter holding means 102, modifies the parameter to record into the parameter holding means 102 as parameters after being modified, and outputs a counter control signal, on the basis of a rotation instruction control signal from the rotation instruction input means 101. In this first embodiment, ~~these~~ the rotation instruction input means 101, the parameter ~~holing~~ holding means 102, and the parameter changing means 103 function as a rotation display control means. Numeral 104 denotes a three-dimensional model coordinate holding means which holds coordinate information of an object constituting the three-dimensional virtual space including the three-dimensional rotation body object, numeral 105 denotes a coordinate transformation means which reads parameter information from the parameter holding means 102, reads a three-dimensional model coordinate from the three-dimensional model coordinate holding means 104 to perform a coordinate transformation, and outputs an after being modified model coordinate, and numeral 106 denotes a perspective transformation means which performs perspective transformation

to a display screen of a three-dimensional virtual space including a three-dimensional rotation body object, employing the after being modified model coordinate outputted from the coordinate transformation means 105 and a view point coordinate, and outputs a coordinate on a projection plane. Numeral 107 denotes a hidden-plane processing means which reads the coordinate on a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area displayed to output depth information and after hidden-plane processed raster information, numeral 108 denotes a depth information holding means which holds the depth information extracted by the hidden-plane processing means 107, and numeral 109 denotes a texture holding means which holds textures mapped to respective plane. In this embodiment, a texture to be mapped to the three-dimensional rotation body object is an image for identifying the corresponding program, and an icon image or the like which corresponds to a program name or a program is employed. Numeral 110 denotes a texture mapping means for mapping the texture read from the texture holding means 109 to the after hidden-plane processed raster information which have considered the depth information by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108. Numeral 111 denotes a rendering means which draws all the pixel information such as

colors or brightness of respective pixels to frame information after being texture mapped outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108, numeral 112 denotes a frame buffer which holds the frame information drawn by the rendering means 111, and numeral 113 denotes a screen displaying means which outputs the frame information held by the frame buffer 112 at a prescribed timing to perform display. In the embodiment, ~~these~~ the means of the three-dimensional model coordinate holding means 104 to screen displaying means 113 function as a selecting object displaying means which displays an image on a display screen, which image comprises an object (selecting object) which ~~have~~ has respectively mapped textures indicating program contents to the respective planes of a three-dimensional rotation body object, ~~which~~ the plural planes being disposed at regular intervals with respect to a center axis, ~~being~~ and disposed in a three-dimensional virtual space. Further, numeral 114 denotes a counter means which increases a counter value by the counter control signal from the parameter changing means 103, numeral 115 denotes a selection input means for a user to decide and input a program to select, numeral 116 denotes a selection plane judging means which judges a selected plane on the basis of the counting information from the counter means 114 and a selection control signal from the selection input means 115, and numeral 117

denotes a correspondence table holding means which holds correspondence tables indicating a correspondence relationship between respective planes composing the three-dimensional rotation body object and programs (plane-to-program correspondence information), and a correspondence relationship between respective planes and textures (plane-to-texture correspondence information). Figure 3 is a diagram exemplifying the correspondence table held by the correspondence table holding means 117. Numeral 118 denotes a program deciding means which decides a program to execute from selection plane information outputted from the selection plane judging means 116 with reference to the correspondence information (plane-to-program correspondence information) read from the correspondence table holding means 117, and numeral 119 denotes a program executing means which executes a program on the basis of selection program information selected by the program deciding means 118.

Next, the operation of the program selection and execution device according to the first embodiment will be described. In the program selection and execution device according to the first embodiment, programs are ~~aldisposed~~ disposed to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space to rotate the same, and when a prescribed operation is performed by a user, ~~activates~~ a program ~~corresponded~~ that corresponds to a plane

which faces front ~~the~~ with respect to a view point of the user is activated.

In the program selection and execution device according to the first embodiment, when a program selecting operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space held in the three-dimensional model coordinate holding means 104 is read, and the perspective transformation means 106 performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing the initial coordinate and a view point coordinate, and outputs a coordinate on a projection plane. That is, at the initial display operation of the program selecting operation mode, the coordinate transformation means 105 does not perform a transformation of a coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 and outputs the coordinate as it is to the perspective transformation means 106. The hidden-plane processing means 107 reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area to be displayed so as to outputs the depth information and the raster information after being hidden-plane processed. The texture mapping means 110 maps the texture read from the texture holding means 109 to the after hidden-plane

processed raster information for which the depth information is considered by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108. Here, the correspondence relationship between respective surfaces of the three-dimensional rotation body object and the textures is obtained by reading the correspondence information (surface-to-plane correspondence information) from the correspondence table holding means 117. The rendering means 111 draws all the pixel information such as colors or brightness of respective pixels to the after texture mapped frame information outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112, and the screen display means 113 reads the frame information held in the frame buffer 112 at a prescribed ~~timing thereby~~timing, to thereby perform a screen display. Thereby, a screen display in the initial state of the program selection operation mode is performed.

~~Figure 2 is a diagram~~Figures 2(a) and 2(b) are diagrams exemplifying a three-dimensional rotation body object disposed in the three-dimensional virtual space in the program selection and execution device according to the first embodiment. In the present invention, the three-dimensional rotation body object disposed in the three-dimensional virtual space comprises

plural surfaces, respective planes being arranged at regular intervals with respect to the center axis. In ~~figure 2~~figures 2(a) and 2(b), there are six planes which compose the three-dimensional rotation body object, ~~and~~ wherein figure 2(a) illustrates ~~one~~ a three-dimensional rotation body object in which the central axis of rotation is disposed in a lateral direction in the three-dimensional virtual space, ~~while~~ and figure 2(b) illustrates ~~one~~ a three-dimensional rotation body object in which the central axis of rotation is disposed in a longitudinal direction in the three-dimensional virtual space.

When a user inputs a rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 103 reads the parameter before being modified (here, parameter in the initial state) from the parameter holding means 102, modifies the parameter to record into the parameter holding means 102 as an after modified parameter, and outputs a counter control signal to the counter means 114, on the basis of the rotation instruction control signal from the rotation instruction input means 101. The coordinate transformation means 105 reads the after being modified parameter which is recorded in the parameter holding means 102 and outputs the after being modified model coordinate, which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate

holding means 104 with employing the after being modified parameter, to the perspective transformation means 106. The perspective transformation means 106 performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing this after being modified model coordinate and the view point coordinate, and outputs the coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen display means 113 perform the same operation as that at the initial display operation of the above-described program selection operation mode, so as to display a screen after the rotation instruction control signal being inputted. For example, ~~in one in which~~if the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), when a rotation instruction control signal in a positive direction is inputted in a state where an image in which the plane 1 faces front in the initial state, a rotation occurs in the direction of an arrow in ~~figure 2 thereby~~ figures 2(a) and 2(b), thereby to display an image in which the plane 2 faces front, while a rotation occurs in a direction reverse to an arrow in ~~figure 2 thereby~~ figures 2(a) and 2(b), thereby to display an image in which the plane 6 faces front.

Here, the rotation instruction input means 101 may make

the operation of a cursor key of a remote control or a keyboard, or the motion of a mouse correspond to the rotation of the three-dimensional rotation body object. For example, ~~in one in which~~if the three-dimensional rotation body object is what is shown in figure 2(a), it may make up and down cursor keys of a remote control or a keyboard correspond to the rotation of the three-dimensional rotation body object in an upward direction (inverse direction of the arrow in figure 2(a)) and a downward direction (direction of the arrow in figure 2(a)), respectively or it may make up-and-down motions of a mouse correspond to the rotations of the three-dimensional rotation body object in the upward direction and the downward direction respectively. In addition, when the operation is performed by a mouse provided with a rotary button referred to as a wheel such as IntelliMouse by Microsoft Ltd., the forward and backward rotations of the wheel may correspond to the rotations of the three-dimensional rotation body object in the upward direction and the downward direction. Further, when the operation is performed by a track ball, the forward and backward rotations of the track ball may correspond to the rotations of the three-dimensional rotation body object in the upward direction and the downward direction. When the operation is performed by an input means employing speech recognition, speech inputs of "up" and "down" or the like may correspond to the rotations of the three-dimensional rotation body object in the upward direction

and the downward direction.

At the rotation instruction control signal inputting operation, in the counter means 114 performs a counting operation by the counter control signal outputted by the parameter changing means 103. Specifically, for example, when the rotation instruction control signal in the positive direction is inputted from the rotation instruction input means 101, the parameter changing means 103 outputs a counter control signal for performing 1-increment of a counter value of the counter means 114, while when the rotation instruction control signal in the negative direction is inputted from the rotation instruction input means 101, the parameter changing means 103 outputs the counter control signal for performing 1-decrement of the counter value of the counter means 114. The counter means 104 receives the counter control signal and changes its counter value.

When a user inputs a selection control signal from the selection input means 115 in a state where a plane displaying the program which is to be activated faces front, the selection plane judging means 116 obtains the count value at that timing from the counter means 114 as the counting information, judges the plane which faces front when the selection control signal is inputted on the basis of the counting information, and ~~output~~ outputs the surface as the selection plane information. For example, ~~in one in which~~ if the three-dimensional rotation

body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), the selection plane judging means 116 judges in the initial state (the counting value is "0") or when a remainder obtained by dividing the counting value by 6 is "0", that the plane which faces front is plane 1, and when the remainder obtained by dividing the counting value by 6 is "1", "2", "3", "4", or "5", that the plane which faces front is plane 2, plane 3, plane 4, plane 5, or plane 6, respectively, and further, when the remainder when obtained by dividing the counting value by 6 is "-1", "-2", "-3", "-4", or "-5", that the plane which faces front is plane 6, plane 5, plane 4, plane 3, or plane 2, respectively.

The program deciding means 118 obtains the selection plane information from the selection plane judging means 116, refers to the plane-to-program correspondence information which is held in the correspondence table holding means 117, and outputs the program corresponding to the plane indicated by the selection plane information as the selection program information.

The program executing means 119 executes the program which is specified by the selection program information inputted from the program deciding means 118.

As described above, the program selection and execution device according to the first embodiment is configured so that it displays ~~a object~~an object (selecting object), in which

textures indicating program contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, rotates the three-dimensional rotation body object by an instruction given through a prescribed operation by a user as well as counts how many times the rotation instruction operation is repeated, judges a plane which faces front the most with respect to a view point of the user from the counting value when a prescribed selecting operation is performed by the user, and selects a program corresponding to the plane with referring to the correspondence table, thereby activating the program. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

Further, as an example of the three-dimensional rotation body object disposed in the three-dimensional virtual space in the program selection and execution device according to the first embodiment, one in which six planes compose the three-dimensional rotation body object and the center axis of rotation is arranged in the lateral and longitudinal direction in the three-dimensional virtual space is described. However, the number of planes composing the three-dimensional rotation

body object is not restricted to 6, and 2-5 planes or 7 or more plane may also be ~~also~~ possible, and further, the rotation body displayed can also be changed in accordance with the number of programs which should be corresponded. It is also possible that when the program number is larger than the number of programs, the program information to be mapped to the plane may be sequentially switched at a prescribed timing, so that all the programs may be selected, or only a specified program such as that which is employed frequently may be selected to perform a display. Further, the center axis of rotation can be arranged in an oblique direction in the three-dimensional virtual space.

(Embodiment 2)

Figure 4 is a block diagram illustrating the configuration of a program selection and execution device according to a second embodiment of the present invention.

In figure 4, the same reference numerals as those shown in figure 1 denote the same or corresponding parts. Numeral 120 denotes a rotation angle changing pattern holding means which holds a rotation angle changing pattern for changing a parameter sequentially so as to rotate a three-dimensional rotation body object in a three-dimensional virtual space, and outputs the modified parameter sequentially in response to a request from a coordinate transformation means 121. In the second embodiment, the rotation angle changing pattern holding

means 120 functions as a rotation display control means. The coordinate transformation means 121 receives a display conclusion signal outputted by the screen display means 113 so as to request the rotation angle changing pattern holding means 120 to output modified parameter information, performs coordinate transformation of a three-dimensional model coordinate, employing the modified parameter information which is outputted by the rotation angle changing pattern holding means 120 in response to the request, and outputs ~~a after~~an after being modified model coordinate ~~as well as outputs~~and a counter control signal to the counter means every time the coordinate transformation is performed.

~~Next the~~Next, the operation of the program selection and execution device according to the second embodiment will be described. The program selection and execution device according to the second embodiment performs an automatic rotation at a prescribed rotation angular velocity, in place of employing a rotation instruction as a user's input.

In the program selection and execution device according to the second embodiment, when a program selecting operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space, which is held in the three-dimensional model coordinate holding means 104, is read, and the perspective transformation means 106 performs perspective transformation to a display screen of

the three-dimensional virtual space including the three-dimensional rotation body object, employing the initial coordinate and a view point coordinate, and outputs a coordinate of a projection plane. That is, at the initial display operation of the program selecting operation mode, the coordinate transformation means 121 does not perform a transformation and outputs a coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 as it is to the perspective transformation means 106. The hidden-plane processing means 107 reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area displayed so as to output the depth information and the after hidden-plane processed raster information. The texture mapping means 110 maps the texture read from the texture holding means 109 to the after hidden-plane processed raster information which have considered the depth information by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108. Here, the correspondence relationship between the respective surfaces of the three-dimensional rotation body object and the textures is obtained by reading the correspondence information (surface-to-texture correspondence information) from the correspondence table holding means 117. The rendering means 111 draws all the pixel

information such as colors or brightness of respective pixels to the after texture mapped frame information outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112. The screen display means 113 reads the frame information held in the frame buffer 112 at a prescribed timing to perform a screen display (display of an image in the initial state of the program selecting operation mode), and when the display operation is completed, issues the display conclusion signal to the coordinate transformation means 121.

Receiving the display conclusion signal from the screen display means 113, the coordinate transformation means 121 requests the rotation angle changing pattern holding means 120 to output a parameter. On the basis of the request from the coordinate transformation means 121, the rotation angle changing pattern holding means 120 outputs a parameter which is modified to rotate the three-dimensional rotation body object from a state where one plane faces front to a state where another plane adjacent thereto faces front, based on the rotation angle changing pattern held therein. The coordinate transformation means 121 receives the changed parameter outputted by the rotation angle changing pattern holding means 120, and outputs the after being modified model coordinate,

which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 with employing the changed parameter, to the perspective transformation means 106, as well as outputs the counter control signal to the counter means 114. A counting operation is performed in the counter means 114 by the counter control signal outputted by the coordinate transformation means 121. The perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing this after being modified model coordinate and the view point coordinate, and outputs a coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen displaying means 113 perform the same operation as that at the display operation displaying an image in the initial state of the above-described program selecting operation mode, so as to display an image in a state where the three-dimensional rotation body object is rotated by a prescribed angle from the initial state. For example, ~~in one in which~~if the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), while an image in which the plane 1 faces front is displayed in the initial state, a rotation occurs in the direction of an arrow in figure 2, thereby to

display an image in which the plane 2 faces front. When the image display operation is completed, the screen display means 113 issues the display conclusion signal to the coordinate transformation means 121. Thereafter, processing of the above-described coordinate transformation, perspective transformation, hidden-plane processing, texture mapping, rendering, and screen display are repeated, ~~thereby~~ and thereby, an image in which the three-dimensional rotation body object, the respective surfaces of which are mapped with textures indicating program contents, is rotated automatically is displayed on a screen.

The operations of the selection plane judging means 116, the program deciding means 118, and the program executing means 119, when a user inputs a selection control signal through the selection input means 115 in a state where a plane which displays the program which is to be activated faces front, are the same as those in the program selection and execution device according to the first embodiment. Accordingly, the selection plane judging means 116 obtains the counting value at that timing from the counter means 114 as the counting information, the plane which faces front when the selection control signal is inputted, is judged on the basis of the counting information, and the plane is outputted as the selection plane information. The program deciding means 118 obtains the selection plane information from the selection plane judging means 116, refers to the plane-to-program correspondence information which is

held in the correspondence table holding means 117, and outputs the program corresponding to the plane which is indicated by the selection plane information as the selection program information. The program executing means 119 executes the program which is specified by inputted selection program information from the program deciding means 118.

As described above, the program selection and execution device according to the second embodiment is configured so that it displays an object (selecting object), in which textures indicating program contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, repeats to modify a parameter automatically so as to rotate the three-dimensional rotation body object from a state where one plane faces front to a state where another plane adjacent thereto faces front, and thereby ~~rotation~~ rotates the three-dimensional rotation body object automatically on a screen, and also ~~counting~~ counts how many times the parameter modification is repeated, judges a plane which faces front the most with respect to a view point of the user from the counting value when a prescribed selecting operation is performed by the user, and selects a program corresponding to the surface with referring to the correspondence table, thereby to activate the program. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an

image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer. Moreover, because the three-dimensional rotation body object is rotated automatically, the user is only required to be cautious about a program selection, thereby further simplifying the operation.

While in the second embodiment, a changing pattern of the rotation angle is described as the changing ~~is~~ always being performed with a constant rotation angle, but a rotation angle changing pattern may be such that the rotation is once halted when a plane of the three-dimensional rotation body object faces front, and the rotation angle is changed after a certain period of time has passed.

Further, there may ~~be~~ also be provided means for performing a manual rotation instruction as in the program selection and execution device according to the first embodiment (rotation instruction input means 101, parameter holding means 102, and parameter changing means), to provide a construction in which rotation is usually performed according to the user's operation, while when the user does not perform the operation for a prescribed period of time, a timer is activated to measure a prescribed time, and when it is exceeded, rotation is again started automatically. Also in this

configuration, it may be constructed such that after the automatic rotation is started, the rotation is halted and the program is selected according to the ~~use's~~ user's operation.

(Embodiment 3)

Figure 5 is a block diagram illustrating the configuration of a program selection and execution device according to a third embodiment of the present invention.

In figure 5, the same reference numerals as those shown in figure 1 denote the same or corresponding parts. Numeral 122 denotes a depth information holding means which holds depth information extracted by the hidden-plane processing means 107, and numeral 123 denotes a selection plane judging means which judges a selected plane according to the depth information from the depth information holding means 122 and the selection control signal from the selection input means 115.

Next, the operation of the program selection and execution means according to the third embodiment will be described. While in the program selection and execution means according to the first embodiment, the number of rotation instruction is counted, thereby to judge a plane selected (plane which faces front), in the program selection and execution means according to the third embodiment, the plane which faces front the most with respect to a view point of a user is judged on the basis of the depth information obtained at the hidden-plane processing, in place of a counting value of the rotation

instruction.

In the program selection and execution means according to the third embodiment, the operation of displaying a screen in the initial state of the program selecting operation mode and the operation by inputting a rotation instruction control signal are exactly the same as those in the program selection and execution means according to the first embodiment, and their descriptions will be omitted.

In the program selection and execution means according to the third embodiment, when a user inputs the selection control signal from the selection input means 115 in a state where a plane which displays the program desired to be activated faces front, the selection plane judging means 123 obtains the depth information at that timing from the depth information holding means 122, the plane which faces front when the selection control signal is inputted is judged based on the depth information, and that plane is outputted as the selection plane information. For example, ~~in one in which~~if the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), the selection plane judging means 123 judges that the plane disposed beforehand at the most in the depth information is a plane which faces front ~~at~~ the most.

The program deciding means 118 obtains the selection plane information from the selection plane judging means 123, refers to the plane-to-program correspondence information which is

held in the correspondence table holding means 117, and outputs the program corresponding to the plane which is indicated by the selection plane information as the selection program information.

The program execution means 119 executes the program which is specified by inputted selection program information from the program deciding means 118.

As described above, the program selection and execution device according to the third embodiment is configured so that it displays an object (selecting object), in which textures indicating program contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, rotates the three-dimensional rotation body object by an instruction ~~give~~ given through a prescribed operation by a user, judges a plane which faces front the most with respect to a view point of the user based on the depth information obtained at the hidden-plane processing, when a prescribed selecting operation is performed by the user, and selects a program corresponding to the plane with referring to the correspondence table, thereby activating the program. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation

environment which is familiar even to a user who is unfamiliar with a personal computer.

In the third embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 103 are provided as a rotation display control means which gives the rotation display control signal for displaying an image in which the selection object is rotated with the central axis as a center of rotation in the three-dimensional virtual space, that is, one in which the rotation instruction input is performed manually; meanwhile, a rotation angle changing pattern holding means 120 may be provided so as to perform the rotation display control automatically as in the program selection and execution device according to the second embodiment.

(Embodiment 4)

Figure 6 is a block diagram illustrating the configuration of a program selection and execution device according to a fourth embodiment of the present invention.

In figure 6, the same reference numerals as those shown in figure 1 denote the same or corresponding parts. Numeral 124 denotes a parameter changing means which reads a parameter before being modified from the parameter holding means 102, changes the parameter to record into the parameter holding means 102 as a parameter after being modified, and ~~outputs~~

~~a~~outputs rotation angle information, according to a rotation instruction control signal from the rotation instruction input means 101. Numeral 125 denotes a selection plane judging means which judges a selected plane according to the rotation angle information from the parameter changing means 124, a selection control signal from the selection input means 115, and rotation-angle-to-plane correspondence information from a rotation-angle-to-plane correspondence holding means 126.

Next, the operation of the program selection and execution device according to the fourth embodiment will be described. While in the program selection and execution means according to the first embodiment, the number of rotation instruction is counted, thereby to judge a plane selected (surface which faces front), in the program selection and execution means according to the third embodiment, a plane which faces front the most with respect to a view point of a user is judged from a correspondence relationship between a rotation angle and a plane index, in ~~p;ace~~place of a counting value of the rotation instruction.

In the program selection and execution means according to the third embodiment, the operation of displaying a screen in the initial state of the program selecting operation mode is exactly the same as that in the program selection and execution means according to the first embodiment, and its description will be omitted.

When a user inputs the rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 124 reads the parameter before being modified (here, parameter in the initial state) from the parameter holding means 102, and changes the parameter to record into the parameter holding means 102 as a parameter after being modified. While in the program selection and execution device according to the first embodiment, the parameter changing means outputs a counter control signal to the counter means 114, in the program selection and execution device according to the fourth embodiment, the parameter changing means 124 outputs a rotation angle information, which indicates how much degree the three-dimensional rotation body object is rotated from the initial state, to the selection plane judging means 125. Thereafter, the coordinate transformation means 105, the perspective transformation means 106, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen display means 113 perform the same operation as those in the program selection and execution device according to the first embodiment, so as to display a screen after the rotation instruction control signal being inputted.

In the program selection and execution means according to the fourth embodiment, when a user inputs the selection control

signal from the selection input means 115 in a state where a plane which displays the program desired to be activated faces front, the selection plane judging means 125 obtains the rotation angle information at that timing from the parameter changing means 124, refers to the ~~rotationangle-to-plane~~rotation angle-to-plane correspondence information held in the ~~rotationangle-to-plane~~rotation angle-to-plane correspondence holding means 126, judges the plane which faces front when the selection control signal is inputted, and outputs the plane as the selection plane information.

~~Figure 7 is a diagram~~Figures 7(a) and 7(b) are diagrams for exemplifying a method of judging the plane which faces front in the program selection and execution device according to the fourth embodiment. ~~Figure 7 shows~~Figures 7(a) and 7(b) show an example of a judgement in a case where the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b) and shows the cross section of the three-dimensional rotation body object. As shown in figure 7(a), for example, in the program selection and execution device according to the fourth embodiment, the vertical line to the plane 1 in the initial state from the axis of rotation is taken as a reference line of the angle, the angle made by the vertical ~~lime eith~~line with respect to plane 1 from the axis of rotation with the reference line is detected as the rotation angle, and the correspondence information between the rotation

angle and the plane is referred to, thereby to judge the plane which faces front. The parameter changing means 124 detects the rotation angle, which is the angle made by the vertical line from the axis of rotation toward the plane 1 with the reference line, and outputs this to the selection plane judging means 125 as the rotation angle information. The three-dimensional rotation body object shown in ~~figure 2~~figures 2(a) and 2(b) is a hexahedron, and when it is rotated by an angle of 60 degrees from the state where one plane faces front, the next plane faces front. A 360-degree rotation from the initial state makes one rotation which ~~ruturns~~ returns to the initial state (rotation angle of 0 ~~degree~~degrees). In this case, the ~~rotationangle-to-plane~~rotation angle-to-plane correspondence information held in the ~~rotationangle-to-plane~~rotation angle-to-plane correspondence holding means 126 may be such that plane 1 to plane 6 correspond to respective ranges of 60 degrees, which are obtained by dividing the rotation angles from 0 ~~degree~~ degrees to 360 ~~degree~~ degrees equally into six ranges of 60 degrees each. Specifically, as shown in figure 7(b), plane 1 corresponds to the rotation angle from 0 ~~degree~~ degrees to 30 ~~degree~~ degrees as well as from 330 ~~degree~~ degrees to 360 ~~degree~~ degrees (0 degree), plane 2 corresponds to the rotation angle from 30 ~~degree~~ degrees to 90 ~~degree~~degrees, plane 3 corresponds to the rotation angle from 90 ~~degree~~ degrees to 150 ~~degree~~degrees, plane 4 corresponds to the

rotation angle from 150 ~~degree~~ degrees to 210 ~~degree~~degrees, plane 5 corresponds to the rotation angle from 210 ~~degree~~ degrees to 270 ~~degree~~degrees, and plane 6 corresponds to the rotation angle from 270 ~~degree~~ degrees to 330 ~~degree~~degrees, respectively.

The program deciding means 118 obtains the selection plane information from the selection plane judging means 125, refers to the plane-to-program correspondence information which is held in the correspondence table holding means 117, and outputs the program corresponding to the plane which is indicated by the selection plane information, as the selection program information.

The program executing means 119 executes the program which is specified by the selection program information inputted from the program deciding means 118.

As described above, the program selection and execution device according to the fourth embodiment is configured so that it displays an object (selecting object), in which textures indicating program contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, rotates the three-dimensional rotation body object by an instruction ~~give~~ given through a prescribed operation by a user, judges a plane which faces front most with respect to a view point of the user based on the rotation angle information

indicating by how ~~much degree~~many degrees the three-dimensional rotation body object is rotated from the initial state when a prescribed selecting operation is performed by the user, and selects a program corresponding to the plane with referring to the correspondence table, thereby activating the program. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

In the fourth embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 124 are provided as a rotation display control means which gives a rotation display control signal for displaying an image in which the selection object is rotated with the central axis as a center of rotation in the three-dimensional virtual space, that is, one in which the rotation instruction input is performed manually; meanwhile, a rotation angle changing pattern holding means 120 may be provided so as to perform the rotation display control automatically as in the program selection and execution device according to the second embodiment.

(Embodiment 5)

Figure 8 is a block diagram illustrating the configuration of a program selection and execution device according to a fifth embodiment of the present invention.

In figure 8, the same reference numerals as those shown in figure 1 denote the same or corresponding parts. Numeral 127 denotes a program executing means which executes a program based on the selection program information selected by the program deciding means 118, and in the fifth embodiment, a program execution screen information is outputted to a screen display switching means 128. The screen display switching means 128 receives a program execution screen information outputted from the program executing means 127, and replaces this with the frame information from the frame buffer or combines this with the frame information, thereby to output the same to the screen displaying means 113.

Next, the operation of the program selection and execution device according to the fifth embodiment will be described. In a case where a program has a display screen at its execution, the program selection and execution device according to the fifth embodiment switches a display of the three-dimensional virtual space to display a program execution screen when the program is selected.

In the program selection and execution means according to the fifth embodiment, the operation of displaying a screen of the initial state in the program selecting operation mode and

the operation by the input of the rotation instruction control signal are exactly the same as those in the program selection and execution device according to the first embodiment, and their descriptions will be omitted.

In the program selection and execution device according to the fifth embodiment, when a user inputs the selection control signal from the selection input means 115 in a state where a plane which displays the program desired to be activated faces front, the selection plane judging means 116 obtains the counting value at that timing from the counter means 114 as the counting information, judges the plane which faces front when the selection control signal is inputted based on the counting information, and outputs this surface as the selection plane information. The program deciding means 118 obtains the selection plane information from the selection plane judging means 116, refers to the plane-to-program correspondence information which is held in the correspondence table holding means 117, and outputs the program corresponding to the plane which is indicated by the selection plane information as the selection program information. The program executing means 127 executes the program whish is specified by the selection program information inputted from the program deciding means 118. At this time, the program executing means 127 outputs the program execution screen information to the screen display switching means 128. The screen display switching means 128

receives the program execution screen information outputted by the program execution means 127, and replaces this with the frame information from the frame buffer 112, to output the same to the screen display means 113.

As described above, the program selection and execution device according to the fifth embodiment is configured so that it displays an object, in which textures indicating program contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, rotates the three-dimensional rotation body object by an instruction give or prescribed operation by a user, judges a plane which faces front the most with respect to a view point of the user when a prescribed selecting operation is performed by the user, selects a program corresponding to the plane with referring to the correspondence table, and activates the program as well as switches to a display of the three-dimensional virtual space so as to display the program execution screen in a case where a program has a display screen at its execution and when the program is selected. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and further, since the execution screen of the selected program is displayed, an easy recognition of the selection can be performed, ~~thereby~~ and

thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

While in the fifth embodiment, a description was given of a case where a display is switched to that of the three-dimensional virtual space and the program execution screen is displayed on full-screen at the display of the program execution screen, it is also possible that a two-dimensional rectangular area (window) is formed additionally and this is displayed with the three-dimensional virtual area, without switching to a full-screen display.

Further, as a method of switching a display, it is also possible to perform switching of the screen display by generating a rectangular object to which program execution screens are mapped as textures, and performing an animation display by interpolating intermediates between a display of a plane of the three-dimensional rotation body object when selected to a position corresponding to the full-screen display.

In the fifth embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 103 are provided as a rotation display control means which gives the rotation display control signal for displaying an image in which the selection object is rotated with the center axis as a center of rotation in the three-dimensional virtual space, that

is, a case where the rotation instruction input is performed manually; meanwhile, rotation angle changing pattern holding means 120 may be provided so as to perform the rotation display control automatically as in the program selection and execution device according to the second embodiment.

Further, in the fifth embodiment, a description was given of a case where the selection plane judging means 116 judges the surface which faces front on the display screen based on the counting information outputted by the counting means 114; meanwhile, the configuration which judges the plane which faces front on the display screen based on the depth information as in the program selection and execution device according to the third embodiment, or the configuration which judges the plane which faces front on the display screen based on the rotation angle information as in the program selection and execution device according to the fourth embodiment may be also provided.

(Embodiment 6)

Figure 9 is a block diagram illustrating the configuration of a data selection and execution device according to a sixth embodiment of the present invention.

In figure 9, numeral 101 denotes a rotation instruction input means which inputs an instruction to rotate a three-dimensional rotation body object in a three-dimensional virtual space, numeral 102 denotes parameter holding means which holds parameters to rotate the three-dimensional rotation body object,

and numeral 103 denotes a parameter changing means which reads a parameter before being modified from the parameter holding means 102 on the basis of a rotation instruction control signal from the rotation instruction input means 101, changes the parameter to record into the parameter holding means 102 as a parameter after being modified, and outputs a counter control signal. Numeral 104 denotes a three-dimensional model coordinate holding means which holds coordinate information of an object constituting the three-dimensional virtual space including the three-dimensional rotation body object, numeral 105 denotes a coordinate transformation means which reads parameter information from the parameter holding means 102, reads a three-dimensional model coordinate from the three-dimensional model coordinate holding means 104 to perform a coordinate transformation, and outputs a model coordinate after being modified, and numeral 106 denotes a perspective transformation means which performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing the model coordinate after being modified outputted from the coordinate transformation means 105 and a view point coordinate, and outputs a coordinate of a projection plane. Numeral 107 denotes a hidden-plane processing means which reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and

not displayed, and extracts only an area to be displayed, to output depth information and raster information after hidden-plane ~~processed, numeral~~processed. Numeral 108 denotes a depth information holding means which holds the depth information extracted by the hidden-plane processing means 107, and numeral 109 denotes a texture holding means which holds a texture mapped to respective plane. In the sixth embodiment, a texture to be mapped to the three-dimensional rotation body object is an image for identifying the corresponding data, and an image may be employed, which image employs an icon image corresponding to data such as, in case of music data, an image in which a name of data such as a name of musical composition or a name of a player or a composer, an image of a player or a composer which is obtained by retrieving ~~a data base~~information from a database provided separately, or an image which reminds a musical composition, while in case of image data of moving image or the like, an image may be employed, which image employs the image of the first portion or a representative portion of the data. Numeral 110 denotes a texture mapping means which maps the texture read from the texture holding means 109 to the raster information after hidden-plane processing the depth of which is considered by the hidden-plane processing means 107, according to the depth information held by the depth information holding means 108. Numeral 111 denotes a rendering means which draws all the pixel information

such as colors or brightness of respective pixels to after texture mapped frame information outputted by the texture mapping means 110, according to the depth information held by the depth information holding means 108, numeral 112 denotes a frame buffer which holds the frame information drawn by the rendering means 111, and numeral 113 denotes a screen display means which outputs the frame information held by the frame buffer 112 at a prescribed timing to perform a display. Further, numeral 114 denotes a counter means which increases a counter by the counter control signal from the parameter changing means 103, numeral 115 denotes selection input means for a user deciding and inputting a program to select, numeral 116 denotes a selection plane judging means which judges a selected plane according to the counting information from the counter means 114 and a selection control signal from the selection input means 115, and numeral 129 denotes a correspondence table holding means which holds correspondence tables indicating a correspondence relationship between respective planes composing the three-dimensional rotation body object and the data (plane-to-data correspondence information), a correspondence relationship between the data and a program (data-to-program correspondence information), and a correspondence relationship between respective planes and textures (plane-to-texture correspondence information). Figure 10 is a diagram exemplifying the correspondence table held by

the correspondence table holding means 129. Numeral 130 denotes a data deciding means which refers to the correspondence information (plane-to-data correspondence information) read from the correspondence table holding means 129, judges a selected data, and outputs selection data information, numeral 131 denotes a program deciding means which decides a program to execute, from the selection data information outputted by the data deciding means 130, with referring to the correspondence information (data-to-program correspondence information) read from the correspondence table holding means, and numeral 132 denotes a program executing means which executes a program according to selection program information selected by the program deciding means 131.

Next, the operation of the data selection and execution device according to the sixth embodiment will be described. The data selection and execution device according to the sixth embodiment allocates application data such as a word processor or a table calculation, or multimedia data such as an image or ~~a music~~music to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space to rotate the same, and activates a program which processes data corresponding to a plane which faces front the most with respect to a view point of the user when a prescribed operation by a user is performed, and opens the selected data.

In the data selection and execution device according to

the sixth embodiment, when a data selecting operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space, which is held in the three-dimensional model coordinate holding means 104, is ~~readout~~read out, and the perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing the initial coordinate and a view point coordinate, and outputs a coordinate of a projection plane. That is, at the initial display operation of the program selection operation mode, the coordinate transformation means 105 does not perform a transformation of a coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 and outputs the coordinate as it is to the perspective transformation means 106. The hidden-plane processing means 107 reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area displayed so as to output the depth information and the raster information after hidden-plane processed. The texture mapping means 110 maps the texture read from the texture holding means 109 to the after hidden-plane processed raster information the depth information of which has been considered by the hidden-plane processing means 107, on the basis of the depth

information held by the depth information holding means 108. Here, the correspondence relationship between respective planes of the three-dimensional rotation body object and the textures is obtained by reading the correspondence information (plane-to-texture correspondence information) from the correspondence table holding means 129. The rendering means 111 draws all the pixel information such as colors or brightness of respective pixels to the after texture mapped frame information outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112, and the screen display means 113 reads the frame information held in the frame buffer 112 at a prescribed timing so as to perform a screen display. Thereby, a screen in the initial state of the program selection operation mode is displayed.

When a user inputs the rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 103 reads the parameter before changed (here, parameter in the initial state) from the parameter holding means 102, changes the parameter to record into the parameter holding means 102 as a parameter after being modified, and outputs the counter control signal to the counter means 114, on the basis of the rotation instruction control signal from the

rotation instruction input means 101. The coordinate transformation means 105 reads the parameter after being modified recorded in the parameter holding means 102 and outputs the model coordinate after being modified, which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 with employing the parameter after being modified, to the perspective transformation means 106. The perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing this model coordinate after being modified and the view point coordinate, and outputs the coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen display means 113 perform the same operation as that at the initial display operation of the above-described data selecting operation mode, so as to display a screen after the rotation instruction control signal is inputted. For example, in a case where the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), when the rotation instruction control signal in a positive direction is inputted, an image in which the plane 1 faces front in the initial state is rotated in a direction of the arrow in ~~figure 2~~figures 2(a) and 2(b) so

that an image in which the plane 2 faces front is displayed, while when the rotation instruction control signal in a negative direction is inputted, an image in which the plane 1 faces front in the initial state is rotated in an inverse direction of the arrow in ~~figure 2~~figures 2(a) and 2(b) so that an image in which the plane 6 faces front is displayed.

As for the rotation instruction input means 101, the operation of a cursor key or the motion of a mouse of a remote control or a keyboard, may be made to correspond to the rotation of the three-dimensional rotation body object as in the first embodiment.

At the rotation instruction control signal inputting operation, a counting operation is performed in the counter means 114 by the counter control signal outputted by the parameter changing means 103. Specifically, for example, when the rotation instruction control signal in the positive direction is inputted from the rotation instruction input means 101, the parameter changing means 103 outputs a counter control signal for performing 1-increment of a counter value of the counter means 114, while when the rotation instruction control means in the negative direction is inputted from the rotation instruction input means 101, the parameter changing means 103 outputs a counter control signal for performing 1-decrement of the counter value of the counter means 114, and the counter means 104 receives this counter control signal and changes its

counter value.

When a user inputs the selection control signal from the selection input means 115 in a state where a plane which displays the data which is desired to be processed faces front, the selection plane judging means 116 obtains the counting value at that timing from the counter means 114 as the counting information, the plane which faces front when the selection control signal is inputted is judged based on the counting information, and the plane is outputted as the selection plane information.

The data deciding means 130 obtains the selection plane information from the selection plane judging means 116, refers to the plane-to-data correspondence information which is held in the correspondence table holding means 129, and outputs the data corresponding to the plane which is indicated by the selection plane information as the selection data information. The program deciding means 131 obtains the selection data information from the data deciding means 130, refers to the data-to-program correspondence information held in the correspondence table holding means 129, and outputs a program which processes data indicated by the selection data information as the selection program information.

The program executing means 132 executes a program which is specified by the selection program information inputted from the program deciding means 131.

As described above, the data selection and execution device according to the sixth embodiment is configured so that it displays an object in which textures indicating data contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, rotates the three-dimensional rotation body object as well as counts how many times the rotation instruction operation is repeated, by an instruction given through a prescribed operation by a user, judges a plane which faces front the most with respect to a view point of the user from the counting value when a prescribed selecting operation is performed by the user, and selects data corresponding to the plane with referring to the correspondence table, thereby activating a program for processing the selected data to open the select data. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

While in the sixth embodiment, a display is performed only by mapping images (textures) for identifying the corresponding data to the surfaces of the three-dimensional rotation body object, it is also possible that textures which indicate

information in characters such as a name of data are mapped to the planes of the three-dimensional rotation body object, and as for the plane of the three-dimensional rotation body object which faces front, a texture which is produced employing an icon image, a still picture extracted from a moving image, or the like, may be displayed on the display screen 200 together with the three-dimensional rotation body object as shown in figure 11.

Further, in the sixth embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 103 are provided as a rotation display control means which gives the rotation display control signal for displaying an image in which the selection object is rotated with the central axis as a center of rotation in the three-dimensional virtual space, that is, a case where the rotation instruction input is performed manually; meanwhile, a rotation angle changing pattern holding means 120 may be provided so as to perform the rotation display control automatically as in the second embodiment.

Further, in the sixth embodiment, a description was given of a case where the selection plane judging means 116 judges the plane which faces front on the display screen based on the counting information outputted by the counting means 114; meanwhile, the configuration which judges the plane which faces

front on the display screen based on the depth information as in the third embodiment, or the configuration for judging the plane which faces front on the display screen based on the rotation angle information as in the fourth embodiment may be provided.

(Embodiment 7)

Figure 12 is a block diagram illustrating the configuration of a data selection and execution device according to a seventh embodiment of the present invention.

In figure 12, the same reference numerals as those shown in figure 9 denote the same or corresponding parts. Numeral 134 denotes a moving image reproducing means which activates the program which is indicated by the selection program information outputted by the program deciding means 131 and reproduces the moving image data indicated by selection data information outputted by the data deciding means 130 to output to the texture holding means 135.

In a case where candidate data to be selected are moving ~~image~~images, the data selection and execution device according to the seventh embodiment maps the moving image to a corresponding plane as a texture, and further, performs moving image display for the plane which faces front, while maps one screen among the moving images as a still picture for the plane which does not faces front.

Thereby, a user can easily judge which surface can be

selected at a timing ~~from by~~based on whether an image mapped to a plane is moving or not.

Next, the operation of the data selection and execution device according to the seventh embodiment will be described. The data selection and execution device according to the seventh embodiment maps moving image data to a corresponding plane as a texture when the candidate data to be selected is a moving image.

In the data selection and execution device according to the seventh embodiment, when a data selection operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space, which is held in the three-dimensional model coordinate holding means 104, is read, and the perspective transformation means 106 performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing the initial coordinate and a view point coordinate, and outputs a coordinate of a projection plane. That is, at the initial display operation of the program selection operation mode, the coordinate transformation means 105 does not perform a transformation of coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 and outputs the coordinate as it is to the perspective transformation means 106. The hidden-plane processing means

107 reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area displayed so as to output the depth information and the raster information after hidden-plane processed. The texture mapping means 110 maps the texture read from the texture holding means 135 to the raster information after hidden-plane processed the depth information of which has been considered by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108.

Here, in the seventh embodiment, the moving image reproducing means 134 reproduces all the data the contents of which should be displayed on respective planes of the three-dimensional rotation body object with referring to the plane-to-data correspondence information and the data-to-program correspondence information held in the correspondence table holding means 129, and outputs one screen among moving images of respective data to the texture holding means 135 as a still picture, for the planes which do not face front, while continues to reproduce data and outputs the moving image to the texture holding means 135, with referring to the plane which faces front. For example, in a case where the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), the moving image reproducing means 134, in the initial state, outputs one screen among moving images of

respective data to the texture holding means 135 as a still picture for the plane 2 to plane 6, while ~~continues~~ continuing to reproduce data and outputs the moving image to the texture holding means 135 for the plane 1.

The correspondence relationship between respective planes of the three-dimensional rotation body object and textures is obtained by reading the correspondence information (plane-to-texture correspondence information) from the correspondence table holding means 129. The rendering means 111 draws all the pixel information such as colors or brightness of respective pixels to the frame information after texture mapped outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112, and the screen display means 113 reads the frame information held in the frame buffer 112 at a prescribed timing so as to perform a screen display. Thereby, a screen in the initial state of the data selection operation mode is displayed.

When a user inputs the rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 103 reads the parameter before changed (here, parameter in the initial state) from the parameter holding means 102, changes the parameter to record into the parameter

holding means 102 as a parameter after changed, and outputs the counter control signal to the counter means 114, on the basis of the rotation instruction control signal from the rotation instruction input means 101. The coordinate transformation means 105 reads the parameter after changed recorded in the parameter holding means 102 and outputs the model coordinate after changed, which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 with employing the parameter after changed, to the perspective transformation means 106. The perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing this model coordinate after changed and the view point coordinate, and outputs the coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen display means 113 perform the same operation as that at the initial display operation of the above-described data selection operation mode, so as to display a screen after the rotation instruction control signal is inputted. For example, in a case where the three-dimensional rotation body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), when the rotation instruction control signal in a positive direction is inputted, an image in

which the surface 1 faces front in the initial state is rotated in a direction of an arrow in ~~figure 2~~figures 2(a) and 2(b) so that an image in which the plane 2 faces front is displayed, while it is rotated in an inverse direction of the arrow in ~~figure 2~~figures 2(a) and 2(b) so that an image in which the plane 6 faces front is displayed, when the rotation instruction control signal in a negative direction is inputted. Here, when plane 2 faces front, the moving image reproducing means 134 outputs one screen among moving images of respective data to the texture holding means 135 as a still picture for the plane 1 as well as for plane 3 to plane 6, while ~~continues~~ continuing to reproduce data and outputs the moving image to the texture holding means 135 for the plane 2. Further, when plane 6 faces front, the moving image reproducing means 134 outputs one screen among moving images of respective data to the texture holding means 135 as a still picture for the plane 1 to plane 5, while ~~continues~~ continuing to reproduce data and outputs the moving image to the texture holding means 135 for the plane 6.

As for the rotation instruction input means 101, the operation of a cursor key or the motion of a mouse of a remote control or a keyboard, may be made to correspond to the rotation of the three-dimensional rotation body object as in the first embodiment.

At the rotation instruction control signal inputting operation, a counting operation is performed in the counter

means 114 by the counter control signal outputted by the parameter changing means 103. Specifically, for example, when the rotation instruction control signal in the positive direction is inputted from the rotation instruction input means 101, the parameter transformation means 103 outputs the counter control signal for performing 1-increment of a counter value of the counter means 114, while when the rotation instruction control means in the negative direction is inputted from the rotation instruction input means 101, the parameter changing means 103 outputs a counter control signal for performing 1-decrement of the counter value of the counter means 114, and the counter means 104 receives this counter control signal and changes its counter value.

When a user inputs the selection control signal from the selection input means 115 in a state where a plane which displays the data which is desired to be processed faces front (a state where a moving image is displayed), the selection plane judging means 116 obtains the counting value at that timing from the counter means 114 as the counting information, the plane which faces front when the selection control signal is inputted is judged based on the counting information, and the plane is outputted as the selection plane information.

The data deciding means 130 obtains the selection plane information from the selection plane judging means 116, refers to the plane-to-data correspondence information which is held

in the correspondence table holding means 129, and outputs the data corresponding to the plane which is indicated by the selection plane information as the selection data information. The program deciding means 131 obtains the selection data information from the data deciding means 130, refers to the data-to-program correspondence information held in the correspondence table holding means 129, and outputs a program which processes data indicated by the selection data information as the selection program information.

The moving image reproducing means 134 executes a program which is specified by the selection program information inputted by the program deciding means 131 and reproduces selected data.

As described above, the data selection and execution device according to the seventh embodiment is configured so that it displays an object in which textures are mapped to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space such that a texture of a moving image of corresponding data reproduced is mapped to a plane which faces front on a display screen, while textures of a still picture of corresponding data are mapped to planes other than the plane which faces front on the display screen, respectively, rotates the three-dimensional rotation body object as well as counts how many times the rotation instruction operation is repeated, by an instruction through a

prescribed operation by a user, judges a plane which faces front the most with respect to a view point of the user by the counting value, when a prescribed selecting operation is performed by the user, and selects data corresponding to the plane with referring to the correspondence table, thereby activating a program for processing the selected data to open the select data. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and it can be easily judged which plane can be selected at a timing ~~from~~ based on whether or not an image mapped to a plane is moving or not, whereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer.

In the seventh embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 103 are provided as a rotation display control means which gives the rotation display control signal for displaying an image in which the selection object is rotated with the central axis as a center of rotation in the three-dimensional virtual space, that is, one in which the rotation instruction input is performed manually; meanwhile, a rotation angle changing pattern holding means may be provided so as to perform the

rotation display control automatically as in the second embodiment.

Further, in the seventh embodiment, a description was given ~~of one~~ in which the selection plane judging means 116 judges the plane which faces front on the display screen based on the counting information outputted by the counting means 114; meanwhile, the configuration for judging the plane which faces front on the display screen based on the depth information as in the third embodiment, or the configuration with judges the plane which faces front on the display screen based on the rotation angle information as in the fourth embodiment may be also provided.

(Embodiment 8)

Figure 13 is a block diagram illustrating the configuration of a data selection and execution device according to an eighth embodiment of the present invention.

In figure 13, the same reference numerals as those shown in figure 9 denote the same or corresponding parts. Numeral 136 denotes a subsequent selection plane judging means which receives selection plane information indicating a plane to be selected at present (plane judged facing front) from the selection plane judging means 116, judges which plane becomes a subsequent plane to be selected with the three-dimensional rotation body object being rotated, and outputs subsequent selection plane information which indicates the subsequent

plane to be ~~selected, numeral~~selected. Numeral 137 denotes a first data deciding means which receives the selection plane information from the selection plane judging means 116, refers to correspondence information (plane-to-data correspondence information) read from the correspondence table holding means 129, judges data which correspond to the plane to be selected at present, and outputs selection data information, numeral 138 denotes a first program deciding means which decides a program to execute from the selection data information outputted by the first data deciding means 137 with referring to correspondence information (data-to-program correspondence information) read from the correspondence table holding means 129, and numeral 139 denotes a data reproducing means which activates a program indicated by the selection program information outputted by the first program deciding means 138, reproduces data indicated by the selection data information outputted by the first data deciding means 137, and outputs reproduction data 1. Numeral 140 denotes a second data deciding means which receives the subsequent selection plane information from the subsequent selection plane judging means 136, refers to the correspondence information (plane-to-data correspondence information) read from the correspondence table holding means 129, judges data which correspond to the subsequent plane to be selected, and outputs subsequent selection data information, numeral 141 denotes a second program deciding means which decides a program

to execute from the subsequent selection data information outputted by the second data deciding means 140 with referring to the correspondence information (data-to-program correspondence information) read from the correspondence table holding means 129, and numeral 142 denotes a subsequent data reproducing means which activates a program indicated by the selection program information outputted by the second program deciding means 141, reproduces data indicated by the subsequent selection data information outputted by the second data deciding means 140, and outputs reproduction data 2. Numeral 143 denotes a mixing means which receives the reproduction data 1 and the reproduction data 2 and produces mixed data to output on the basis of the rotation of the three-dimensional rotation body object, and numeral 144 denotes a data output means which makes the mixed data from the mixing means 144 subjected to picture display or sound display.

Next, the operation of the data selection and execution device according to the eighth embodiment will be described. ~~In one in which~~If objective data to be selected are sound/music data or moving image data, or sound/music data accompanying the moving image data, when data corresponding to a plane which at a timing is switched to data of a subsequent plane, the data selection and execution device according to the eighth embodiment switches between fade-in and fade-out based on patterns of a mixing ratio between levels of sound and

luminance according to the rotation angle.

In the data selection and execution device according to the eighth embodiment, when a data selecting operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space, which is held in the three-dimensional model coordinate holding means 104, is read, and the perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing the initial coordinate and a view point coordinate, and outputs a coordinate of a projection plane. That is, at the initial display operation of the program selecting operation mode, the coordinate transformation means 105 does not perform a transformation of a coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 and outputs the coordinate as it is to the perspective transformation means 106. The hidden-plane processing means 107 reads the coordinate of a projection plane from the perspective transformation means 106, removes an area which is hidden and not displayed, and extracts only an area displayed so as to output the depth information and the raster information after hidden-plane processed. The texture mapping means 110 maps the texture read from the texture holding means 109 to the raster information after hidden-plane processed the

depth information of which has been considered by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108. The correspondence relationship between respective ~~plane~~ planes of the three-dimensional rotation body object and textures is obtained by reading the correspondence information (plane-to-texture correspondence information) from the correspondence table holding means 129. The rendering means 111 draws all the pixel information such as colors or brightness of respective pixels to the frame information after texture mapped outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112, and the screen displaying means 113 reads the frame information held in the frame buffer 112 at a prescribed timing so as to perform a screen display. Thereby, a screen in the initial state of the data selecting operation mode is displayed.

Here, in the eighth embodiment, the data reproducing means 139 and the subsequent data reproducing means 142 reproduce data corresponding to the plane which faces front and data corresponding to the subsequent plane which faces front among planes composing the three-dimensional rotation body object, respectively, and ~~output~~ outputs them to the mixing means 143. For example, ~~in one in which~~ if the three-dimensional rotation

body object has the shape shown in ~~figure 2~~figures 2(a) and 2(b), in the initial state, the data reproducing means 139 reproduces data corresponding to plane 1 and the subsequent data reproducing means 142 reproduces data corresponding to plane 2, respectively, to output to the mixing means 143. The mixing means 143, in the initial state, outputs a composite signal of the mixing ratio in which a reproduction signal of the data corresponding to plane 1 is maximum while a reproduction signal of the data corresponding to plane 2 is minimum. That is, in the initial state, only the reproduction signal of the data corresponding to plane 1 is outputted to the data output means 144, and the data output means 144 makes the reproduction signal subjected to image display or sound display. A method of image display may be one which performs displaying on the display screen 200 with the three-dimensional rotation body object as shown in figure 11.

When a user inputs the rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 103 reads the parameter before modified (here, parameter in the initial state) from the parameter holding means 102, changes the parameter to record into the parameter holding means 102 as a parameter after changing, and outputs the counter control signal to the counter means 114, on the basis of the rotation instruction control signal from the

rotation instruction input means 101.

With respect to the rotation instruction input means 101, the operation of a cursor key or the motion of a mouse of a remote control or a keyboard, may be made to correspond to the rotation of the three-dimensional rotation body object as in the first embodiment.

The coordinate transformation means 105 reads the parameter after changing recorded in the parameter holding means 102 and outputs the model coordinate after changing, which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 with employing the parameter after changing, to the perspective transformation means 106. The perspective transformation means 106 performs perspective transformation to a display screen of the three-dimensional virtual space including the three-dimensional rotation body object, employing this model coordinate after changing and the view point coordinate, and outputs the coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen display means 113 perform the same operation as that at the initial display operation of the above-described data selecting operation mode, so as to display a screen after the rotation instruction control signal is inputted.

For example, ~~in one in which~~if the three-dimensional rotation body object has the shape shown in figure 2(a), it is displayed with its plane 1 ~~faces~~ facing front in the initial state (time t0), while an image in which plane 2 faces front is displayed at time t1 by an input of the rotation instruction signal, as shown in figure 14(a). At this timing, the mixing means 143 in the eighth embodiment gradually decreases the mixing ratio of the reproduction signal of the data corresponding to plane 1 as well as gradually increases the mixing ratio of the reproduction signal of the data corresponding to plane 2 so that the reproduction signal of the data corresponding to plane 1 is minimum and the reproduction signal of the data corresponding to plane 2 is maximum at time t1, while the composite signal of the mixing ratio in which the reproduction signal of the data corresponding to plane 1 is maximum and the reproduction signal of the data corresponding to plane 2 is minimum is outputted in the initial state. Therefore, displays of the reproduction signal of the data corresponding to plane 1 and of the reproduction signal of the data corresponding to plane 2 are subjected to cross fade and switched as shown in figure 14(b). When a display output of the reproduction signal of the data corresponding to plane 1 is 0, the data reproducing means 139 switches data to reproduce from the data corresponding to plane 1 to the data corresponding to plane 2 and the subsequent data reproducing

means 142 switches data to reproduce from the data corresponding to plane 2 to data corresponding to plane 3. On the basis of an image display in which a state where plane 2 faces front is switched to a state where plane 3 faces front, the mixing means 143 outputs the composite signal so that a display of the reproduction signal of the data corresponding to plane 2 and a display of the reproduction signal of the data corresponding to plane 2 are subjected to cross fade and switched. By repeating this operation, the object (selecting object), in which textures indicating data contents are mapped respectively to respective planes of the three-dimensional rotation body object, can be displayed on the display screen, as well as music data or moving image data corresponding to the plane faces front can be subjected to an auxiliary display continuously.

When a user inputs the selection control signal from the selection input means 115 in a state where the plane which displays the data desired to be processed faces front, the selection plane judging means 116 outputs a selection display signal which indicates that a plane indicated by the selection plane information outputted at that timing is actually selected. The first data deciding means 137 and the first program deciding means 138 transmit the selection display signal to the data reproducing means 139. The data reproducing means 139 receives the selection display signal, reproduces the selected

data again from the beginning employing a presently running program, and outputs the reproduction data to the mixing means 143 with the selection display signal. Receiving the selection display signal, the mixing means 143 stops mixing the reproduction data 1 and the reproduction data 2 and outputs the reproduction data 1 and the selection display signal to the data output means 144. Receiving the selection display signal, the data output means 144 switches a screen display from a screen in which the selecting object is displayed to a screen for data display and performs a display of the reproduction data 1.

As described above, the data selection and execution device according to the eighth embodiment is configured so that it displays the object, in which textures indicating data contents are mapped respectively to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, on a screen, performs auxiliary display of music data or moving image data which correspond to the plane that faces front continuously, and reproduces data corresponding to the plane which faces front most with respect to a view point of the user, when a prescribed selecting operation is performed by the user. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated,

whereby it is possible to realize an intuitive operation environment which is familiar even to a user who is unfamiliar with a personal computer, and further, because music data or moving image data which are subjected to auxiliary display with the selecting object are continuous, a data selection and execution device which enables a user to perform data selection comfortably can be realized.

In the eighth embodiment, a description was given ~~of one~~ in which a display of the reproduction signal of the data corresponding to the selected plane and a display of the reproduction signal of the data corresponding to the subsequent plane to be selected are subjected to cross fade and switched, and it is also possible that a display of the reproduction signal of the data corresponding to the selected plane are faded out, and thereafter, a display of the reproduction signal of the data corresponding to the subsequent plane to be selected are faded in. In this case, since it is not required to reproduce two pieces of data simultaneously, there is no need to provide the data deciding means, the program deciding means, and data reproducing means in double.

Further, in the eighth embodiment, a description was given ~~of one~~ in which the rotation instruction input means 101, the parameter holding means 102, and the parameter changing means 103 are provided as a rotation display control means which gives the rotation display control signal for displaying an

image in which the selection object is rotated about the central axis as a center of rotation in the three-dimensional virtual space, that is, one in which the rotation instruction input is performed manually; meanwhile, a rotation angle changing pattern holding means may be provided so as to perform the rotation display control automatically as in the second embodiment.

Further, in the eighth embodiment, a description was given of one in which the selection plane judging means 116 judges the plane which faces front on the display screen based on the counting information outputted by the counting means 114; meanwhile, the configuration ~~with~~ which judges the plane faces front on the display screen based on the depth information as in the third embodiment, or the configuration ~~with~~ which judges the plane faces front on the display screen based on the rotation angle information as in the fourth embodiment may be provided.

Recently, so-called three-dimensional sound has come into practical use which, applying signal processing technology, develops usual sound and outputs this from a speaker in consideration of the sound source position in the three-dimensional space, thereby to make it sound overhead or sound as if the sound were moving from right to left. It is possible to apply the art of this three-dimensional sound to the data selection and execution device according to the eighth

embodiment, so that the reproduction sound source position of sound data which correspond to a plane of the three-dimensional rotation body object moves correspondingly to the rotation of the three-dimensional rotation body object, thereby to enable a user to easily recognize which plane can be selected at present by hearing the reproduction ~~sound~~ sound, the sound source position of which moves.

~~Figure 15 is a diagram~~ Figures 15(a) to 15(c) are diagrams for explaining the operation of switching a reproduction sound display when the art of the three-dimensional sound is applied to the data selection and execution device according to the eighth embodiment. In ~~the figure~~figures 15(a) to 15(c), the upper portion thereof illustrates how the three-dimensional rotation body object looks on the display screen. This example illustrates ~~one in which~~ the number of planes composing the three-dimensional rotation body object ~~is~~ as being six, the central axis of rotation is disposed in a longitudinal direction in the three-dimensional virtual space, and the three-dimensional rotation body object is rotated in a counterclockwise direction, when seen from the direction of the central axis of rotation (See the lower in figure 15). As shown ~~in the figure, at the timing~~ in figure 15(a) (initial state), a sound display is performed such that the sound source position of sound data corresponding to plane 1 (corresponding to the reproduction data 1 in figure 13) is in the middle of

the screen, while the sound source position of sound data corresponding to plane 2 (corresponding to the reproduction data 2 in figure 13) is in a left-hand space facing the screen. Then, the sound source position in the sound display is controlled so that the sound source position of the sound data corresponding to plane 1 moves to a right-hand space facing the screen, while the sound source position of the sound data corresponding to plane 2 comes to the middle of the screen as shown in figure 15(b), and at the timing in figure 15(c) (a state where plane 2 faces front), the sound display is performed so that the sound source position of the sound data corresponding to plane 2 is in the middle of the screen, while the sound source position of the sound data corresponding to plane 1 is in a right-hand space facing the screen, in concert with the rotation of the three-dimensional rotation body object. As described above, sound data which correspond to respective planes of the three-dimensional rotation body object are subjected to reproduction display so that their sound source positions move in concert with the rotation of the three-dimensional rotation body object, whereby a user can easily recognize what sound data are selectable by three-dimensional sound. A method of deciding the sound source position in a sound display control may be one which allocates a sound source of sound data corresponding to a plane at a position at a prescribed distance on an extension line of a line which

connects the axis of rotation and the middle of the above-described plane as shown in ~~figure 16~~figures 16(a) to 16(c), while other methods are also possible, such as one which projects a sound source of sound data corresponding to a plane onto a line that is parallel to the display screen from a position at a prescribed distance on an extension line of a line which connects the axis of rotation and the middle of the above-described plane, thereby to allocate, as shown in figure 17.

(Embodiment 9)

Figure 18 is a block diagram illustrating the configuration of an image display device according to a ninth embodiment of the present invention.

In figure 18, numeral 1101 denotes an image receiving means which receives an input signal transmitted via broadcast or a network and outputs an input image signal, numeral 1104 denotes a memory means which holds the input image signal, numeral 1103 denotes a memory input/output control means which writes the input image signal to the memory means 1104, as well as outputs a memory control signal to the memory means 1104 based on area cut-out information which indicates the position when cutting out an area employed as a texture from the input image signal, and reads a partial image signal from the memory means 1104, numeral 1102 denotes a parameter separating means which separates three-dimensional coordinate information and

the area cut-out information from parameter information, which comprises the three-dimensional coordinate information and the area cut-out information, and outputs the area cut-out information to the memory input/output control means 1103 while ~~outputs~~ outputting the three-dimensional coordinate information to an object position deciding means 1105, numeral 1105 denotes an object position deciding means which disposes a three-dimensional object in a three-dimensional virtual space based on the three-dimensional coordinate information from the parameter separating means 1102, and outputs object coordinate information of the three-dimensional object in the three-dimensional virtual space, as well as outputs object disposition order information from the object coordinate information in response to a user's input, numeral 1110 denotes an object position comparing means which compares positions of respective objects based on the object allocation order information from the object position deciding means 1105, selects an object on a prescribed condition, and outputs selection object information, numeral 1111 denotes a channel deciding means which decides a channel which corresponds to the selected object from the selection object information from the object position comparing means 1110 and channel correspondence information from the parameter separating means 1102, and outputs channel information, numeral 1106 denotes a perspective projection transformation means which performs perspective

projection of the object coordinate information of the three-dimensional object from the object position deciding means 1105 onto a display projection plane, and transforms this to display projection plane coordinate information, numeral 1107 denotes a rasterizing means which performs texture mapping of the partial image signal read from the memory input/output control means 1103 onto a prescribed plane of the three-dimensional object based on the projection plane coordinate information from the perspective projection transformation means 1106, and generates and outputs three-dimensional image signal, numeral 1108 denotes a frame memory means which holds the three-dimensional image signal from the rasterizing means 1107 and outputs an output image signal at a prescribed timing, and numeral 1109 denotes an image display means which displays the output image signal from the frame memory means 1108 or the input image signal from the image receiving means 1101.

Next, the operation of the image display device according to the ninth embodiment will be described. The image display device according to the ninth embodiment cuts out an area which is to be employed as a texture from the input image signal transmitted via broadcast or a network or the input image signal as a multi-screen, maps the texture to respective surfaces of the three-dimensional rotation body object disposed in the three-dimensional virtual space, thereby performing channel selection.

In the image display device according to the ninth embodiment, an initial channel of an input signal received by the image receiving means 1101 is a multi-screen image composed of plural partial images.

First, when the input signal such as a divided screen or a multi-screen which comprises a prescribed and plural number of independent images is inputted to the image receiving means 1101, the input image signal is outputted to the memory input/output control means 1103 from the image receiving means 1101.

The memory input/output control means 1103 outputs the memory control signal to the memory means 1104, extracts the partial image signal from the input image signal held in the memory means 1104 based on a cut-out coordinate of the area cut-out information and outputs the partial image signal to the rasterizing means 1107.

The rasterizing means 1107 maps the partial image signal as a texture to the three-dimensional object which is subjected to perspective projection on to a display, based on the projection plane coordinate information from the perspective projection transformation means 1106. At this time, the rasterizing means 1107 needs to repeat the processing for the number of the partial images composing the multi-screen, and thereby, outputs the parameter output control information outputted from the rasterizing means 1107 to the parameter

separating means 1102 by that number of times. An image generated in the rasterizing means 1107 with the three-dimensional drawing operation being repeated in this way is outputted to the frame memory means 1108 as a three-dimensional image signal.

The frame memory means 1108 outputs the output image signal to the image display means 1109 at a prescribed timing and an image is watched. The image displayed here is the three-dimensional rotation body object disposed in the three-dimensional virtual space, respective planes of which are mapped with the partial image signal separated from the input image signal as textures, and the three-dimensional rotation body object is illustrated in ~~figure 2~~figures 2(a) and 2(b).

Meanwhile, when a user's input is inputted by pushing a selection button or the like, the object position deciding means 1105 decides the position of the three-dimensional object in the three-dimensional virtual object based on the three-dimensional coordinate information, and outputs the object coordinate information to the perspective projection transformation means 1106. The perspective projection transformation means 1106 performs perspective projection transformation of the object coordinate information onto the display projection plane, and outputs this to the rasterizing means 1107 as the projection plane coordinate information.

When a user performs an input in a state where a plane

displaying the channel desired to be displayed ~~is~~ faces front, the object position deciding means 1105 outputs the object disposition order information to the object position comparing means 1110, compares a positional relationship between objects, decides an object selected on a prescribed condition, and outputs the selection object information to the channel deciding means 1111.

The channel deciding means 1111 decides a channel which corresponds to the selection object information outputted from the object position comparing means 1110, referring to the channel correspondence information outputted by the parameter separating means 1102, and outputs this to the image receiving means 1101 as the channel information.

The image receiving means 1101 switches a receiving channel based on the channel information and outputs the input image signal to the image display means 1109.

The image display means 1109, when receiving an input of the input image signal, stops a display of the output image signal from the frame memory means 1108 to switch to the input image signal, and performs a display. In this case, an image displayed is a full-screen display of a channel selected by a user.

Figure 19 is a conceptual diagram concerning a three-dimensional display according to the ninth embodiment. In figure 19, numeral 201 denotes the input image signal in a case

of a four division multi-screen, numeral 202 denotes the three-dimensional rotation body object disposed in the three-dimensional virtual space, and numeral 203 denotes the display projection plane when the three-dimensional rotation body object is displayed on a display. In the present invention, the three-dimensional rotation body object disposed in the three-dimensional virtual space is a three-dimensional object which is composed of plural surfaces, ~~which~~ the respective surfaces are being disposed at regular intervals with respect to the central axis. Figure 19 illustrates ~~one in which there are~~ four planes composing the three-dimensional rotation body object, and the central axis of the rotation is arranged in a longitudinal direction in the three-dimensional virtual space.

When the input image signal 201 is inputted to the image receiving means 1101 as an input signal, the image receiving means 1101 outputs the input image signal to the memory input/output control means 1103. The partial image signal which is extracted from the memory input/output control means 1103 based on the area cut-out information is outputted to the rasterizing means 1107, and respective partial images are mapped to respective planes of the three-dimensional object 202 as textures. The three-dimensional object 202 generated in the rasterizing means 1107 is projected onto the display projection plane 203.

~~Figure 20 is a~~ Figures 20(a) and 20(b) are schematic

~~diagram~~ diagrams concerning information required for the three-dimensional display in the ninth embodiment. Figure 20(a) illustrates input images in the four-division multi-screen, and shows apex coordinates (1) of the cut-out areas along division boundaries of respective partial images are described at the bottom of the figure. Figure 20(b) illustrates the three-dimensional object, and shows apex coordinates (2) of the three-dimensional object, correspondences (3) between the apex coordinates of the three-dimensional object and area cut-out coordinates of partial images, and the distance (4) from a view point to the display projection plane as well as the distance from the view point to the origin of the three-dimensional virtual space, as information required for perspective transformation are described at the bottom of the figure.

As is shown from figure 18, the parameter information inputted to the parameter separating means 1102 includes the coordinate information, the perspective transformation information, and the channel correspondence information corresponding to respective surfaces of the three-dimensional object shown by (1) to (4) in figures ~~20~~20(a) and 20(b). Then the three-dimensional coordinate information including the apex coordinate of the three-dimensional object (2), correspondence (3) between the apex coordinate of the three-dimensional object and cut-out coordinate, and the information for perspective transformation (4) are outputted from the parameter separating

means 1102 to the object position deciding means 1105. Further, the cut-out coordinate (1) is outputted to the memory input/output control means 1103 as area-cut-out information. The channel correspondence information is outputted to the channel deciding means 1111.

Therefore, with respect to the three-dimensional coordinate information outputted by the parameter separating means 1102, the coordinate information whose parameter information varies with time change is prepared, thereby realizing a three-dimensional animation display.

Figure 21 is a schematic diagram concerning a channel selection method according to the ninth embodiment. In figure 21, numeral 204 denotes an input image signal in a case of the four-division multi-screen, and the three-dimensional objects corresponding to the four partial images are disposed in a circle to be rotated, so that a three-dimensional animation is displayed. Numeral 205 denotes a view of the three-dimensional object seen from above, and time passes from left to right in the figure. Numeral 206 denotes an image on the display projection plane and numeral 207 denotes a selected image.

In step S1, when a selection button is pushed at the point of an arrow, a channel is selected by a prescribed judgment criteria. In step S2, ~~one~~ a channel which is closet from a view point and has a large display area is selected as a judgment criteria. In figure 21, the corresponding partial

images are circle 1, and an image which is switched to a channel corresponding to circle 1 is displayed (207).

~~Figure 22 is a~~ Figures 22(a) and 22(b) are schematic ~~diagram~~ diagrams concerning a judgment criteria for a channel selection according to the ninth embodiment. Figure 22(a) illustrates a first judgment criteria for channel selection and figure 22(b) illustrates a second judgment criteria for the channel selection. In ~~figure 22~~figures 22(a) and 22(b), numerals 208 and 210 denote views of the three-dimensional object seen from above, and numerals 209 and 211 ~~denotes~~ denote images on the display projection plane.

A judgment criteria in figure 22(a) is that in which a ~~one~~ channel which is closest ~~to~~ from a view point and has a large display area is ~~selected as similarly in~~selected, similar to the description of figure 23.

A judgmental standard in figure 22(b) is that in which judgment is performed ~~by to what~~based on the extent to which the object is inclined with respect to the display plane, i.e., by the absolute value of an angle made by a straight line (dotted line in the figure) constituted by a reference position of the object and the center of the object and a reference axis. In figure 22(b), PQ denotes a reference axis, O denotes the center of rotation, A1 denotes a reference position of circle 1, A2 denotes a reference position of circle 2, A3 denotes a reference position of circle 3, and A4 denotes a reference

position of circle 4. The judgement on which plane among circle 1 to circle 4 is to be selected comes from comparison of angle A1-O-P, angle A2-O-P, angle A3-O-P, and angle A4-O-P, and selecting the smallest angle. In case of figure 22(b), the angle A1-O-P is smallest and circle 1 is selected.

Further, when transformation is performed employing an affine transformation means in place of the perspective projection transformation means 1106, the amount of operation can be reduced, because the affine transformation means executes two-dimensional coordinate operation while the perspective projection transformation means 1106 executes three-dimensional coordinate operation.

Figure 23 is an exemplary diagram showing a difference between the perspective projection transformation and the affine transformation. In figure 23, numeral 212 denotes an image which function as a basis of texture mapping, which is illustrated by a gridiron picture for simplifying the description. Numeral 213 denotes an image in case of the perspective projection transformation and numeral 214 denotes an image in case of the affine transformation. In the image 213 of the perspective projection transformation, the widths of gridiron are wider at beforehand, while in the image 214 of the affine transformation, the widths of gridiron are almost equal. Therefore, while it is possible to express more depth feeling in case of the perspective projection transformation than in

case of the affine transformation, ~~while~~ either ~~ones~~ type of transformation can keep the depth feeling coming from an overview of the object.

As described above, the image display device according to the ninth embodiment is configured so that it displays an object in which textures are mapped to prescribed planes of the three-dimensional object, with respect to the input image signal transmitted via broadcast or a ~~network or~~network, or the input image signal which is referred to as a division screen or a multi-screen, in which comprises a prescribed and plural number of independent images, and displays an image when a prescribed selecting operation is performed by a user. Therefore, it is possible to omit procedures of selecting an objective program by a cursor movement ~~whole~~ while performing the program selection by a remote control, and further, even when the division number is increased and a partial image for a program is reduced, an object is disposed closest to the view point in the three-dimensional virtual space, whereby an enlarged presentation is made possible, enabling a visually clear image presentation.

Further, the coordinate of the three-dimensional object of a prescribed three-dimensional shape information varies with time, thereby obtaining an effect of three-dimensional animation.

Further, by employing the affine transformation ~~inplace~~ in

place of the perspective projection transformation means 1106, the amount of operation can be reduced with the depth being kept to some extent.

In the ninth embodiment, ~~one in which~~ the three-dimensional rotation body object ~~which~~ includes four planes and ~~whose~~ the central axis of rotation is arranged in a longitudinal direction in the three-dimensional virtual space was described as an example of the three-dimensional rotation body object disposed in the three-dimensional virtual space; meanwhile, the number of planes composing the three-dimensional rotation body object may be 1-3 planes or 5 planes or more. Further, it is also possible to change a rotation body displayed in accordance with a corresponding input image signal. In addition, it is also possible to arrange the central axis of rotation in a lateral direction or in an oblique direction in the three-dimensional virtual space.

Further, while the parameter information is separated into the area cut-out information and the three-dimensional coordinate information in the parameter separating means 1102 according to the image display device in the ninth embodiment, this may not be considered as restrictive, and the configuration may be such that the parameter information and the area cut-out information are multiplexed in the input signal, so as to inputted to the image receiving means 1101 and be separated therein.

(Embodiment 10)

Figure 24 is a block diagram illustrating the configuration of an image display device according to a tenth embodiment of the present invention.

In figure 24, the same reference numerals as those shown in figure 18 denote the same or corresponding parts. Numeral 1301 denotes an area separating means which separates an area from an input image signal outputted from the image receiving means 1101 based on an area cut-out information outputted from the parameter separating means 1102, and outputs an image signal for memory storage to be held in the memory means 1104 via the memory input/output control means 1103. Further, unlike in the above-mentioned ninth embodiment, the memory means 1104 does not hold an input signal but holds only a partial image signal that is required for texture mapping processing of the rasterizing means 1107.

Next, the operation of the image display device according to the tenth embodiment will be described. The image display device according to the tenth embodiment cuts out an area from the input image signal, and holds only the cut-out area in the memory without holding the whole image in the memory while mapping these to planes of the object in the three-dimensional virtual area.

The image display device according to the tenth embodiment is the same as the ninth embodiment except for the operation of

the configuration in which the area separating means 1301 is added, and only elements different from the ninth embodiment will be described.

When an input signal is inputted to the image receiving means 1101, parameter information, which includes an apex coordinate of a cut-out area along the division boundaries of respective partial images of the input image signal, is inputted to the parameter separating means 1102. The area cut-out information outputted from the parameter separating means 1102 is inputted to the area separating means 1301 as well as inputted to the memory input/output control means 1103. Then, the area separating means 1301 separates areas from the input image signal outputted from the image receiving means 1101 on the basis of the area cut-out information, and outputs these to the memory input/output control means 1103 as the image signal for memory storage.

The memory input/output control means 1103 outputs the memory control signal to the memory means 1104 based on a cut-out coordinate of the area cut-out information, extracts the partial image signal from the image signal for memory storage held in the memory means 1104, and outputs these to the rasterizing means 1107.

Unlike in the above-mentioned ninth embodiment, in the rasterizing means 1107, the memory means 1104 does not hold the whole input image signal but holds only the partial image

signals that are required for texture mapping processing in the rasterizing means 1107.

Figure 25 is a schematic diagram exemplifying the memory holding for partial images according to the tenth embodiment of the present invention. Referring to figure 25, numeral 215 denotes the input image signal in case of a four division multi-screen, numeral 216 denotes the partial image signal to be held in the memory, and numeral 217 denotes a view of the three-dimensional object seen from above, where time passes from left to right in the figure. Numeral 218 denotes an image on the display projection plane.

The input image signal 215 has an area cut out for the partial image signal 216 to be held in the memory means 1104 on the basis of the area cut-out information from the parameter separating means 1102, and only the cut-out area is held in the memory means 1104. The partial image signal 216 held in the memory means 1104 is outputted to the rasterizing means 1104 and is subjected to texture mapping processing onto a prescribed plane of the three-dimensional object. Therefore, only the image 218 on the display projection plane is stored in the memory and images which are not projected are not held. That is, when noticing a view at the left end of the view 217 of the three-dimensional object seen from above, a screen of circle 1 which is displayed on a display is held in the memory means 1104 as the partial image signal 216, and other screens

of circle 2 to circle 4 are not held in the memory means 1104.

As described above, the image display device according to the tenth embodiment receives the input signal, which is transmitted via broadcast or a network and comprises a prescribed number of partial images, in the image receiving means 1101, outputs the input image signal, separates an area from the input image signal based on the area cut-out information, and holds only the cut-out area in the memory without holding the whole image in the memory, while mapping this to a plane of the object in the three-dimensional virtual area, whereby the memory amount is reduced.

Further, while the parameter information is separated into the area cut-out information and the three-dimensional coordinate information in the parameter separating means 1102 according to the image display device in the tenth embodiment, this should not be considered as restrictive, and the configuration may be such that the parameter information and the area cut-out information are multiplexed in the input signal, so as to be inputted to the image receiving means 1101 and be separated therein.

(Embodiment 11)

Figure 26 is a block diagram illustrating the configuration of an image display device according to an eleventh embodiment of the present invention.

In figure 26, the same reference numerals as those shown

in figure 18 denote the same or corresponding parts. Numeral 1401 denotes, unlike the parameter separating means 1102 in the ninth embodiment, denotes a parameter generating means which automatically generates three-dimensional coordinate information and area cut-out information based on area number information, and numeral 1402 denotes an image analyzing means which analyzes an input image signal as a multi-screen image comprising plural partial images, which is inputted from the image receiving means 1101, to calculate the number of the partial images, and outputs the area number information to the parameter generating information.

Next, the operation of the image display device according to the eleventh embodiment will be described. The image display device according to the eleventh embodiment receives and recognizes the division number of an image transmitted on a multi-screen, and generates a shape information of the three-dimensional object on the basis of the division number.

The image display device according to the eleventh embodiment is the same as the ninth embodiment except for the operation of the configuration in which the parameter generating means 1401 and the image analyzing means 1402 are added, and only elements different from the ninth embodiment will be described.

First, the image receiving means 1101 receives an input signal which is transmitted via broadcast or a network and

comprises a prescribed number of partial images, and outputs the input image signal to the memory input/output control means 1103 as well as to the image analyzing means 1402. The image analyzing means 1402 outputs the area number information in which a prescribed number is judged from the input image signal to the parameter generating means 1401. The parameter generating means 1401 automatically generates parameter information which comprises three-dimensional coordinate information and area cut-out information indicating the position where an area employed for a texture is to be cut out from the input image signal, based on the area number information, separates the area cut-out information and the three-dimensional coordinate information, and outputs the area cut-out information to the memory input/output control means 1103 as well as outputs the three-dimensional coordinate information to the object position deciding means 1105 based on parameter output control information.

~~Figure 27 is a~~ Figures 27(a) to 27(d) are schematic ~~diagram~~ diagrams illustrating a generation of three-dimensional information according to the eleventh embodiment of the present invention. Figure 27(a) illustrates the input image signal in a case of two division, figure 27(b) illustrates the input image signal in a case of four division, figure 27(c) illustrates the input image signal in a case of six division, and figure 27(d) illustrates the input image signal in a case

of nine division. The views at the bottom of the division input image signal are views showing a disposition method seen from above by which automatically generated three-dimensional objects are disposed.

Referring to ~~figure 27~~figures 27(a) to 27(d), when an image with divide into n is inputted to the image receiving means 1101, the input image signals divided into n pieces are outputted to the image analyzing means 1402. The image analyzing means 1402 judges the division number of the image (in this case, division number is n), prepares n pieces of planes of the three-dimensional object which are to be mapped as textures on the basis of the division number, and disposes the planes in a circle at regular intervals so as to form n angles in a circle (view at the bottom in figure 27).

As described above, the image display device according to the eleventh embodiment receives the input signal, which is transmitted via broadcast or a network and comprises a prescribed number of partial images, in the image receiving means 1101, outputs the input image signal, judges the division number of an image in the image analyzing means 1402, and generates the shape information of the three-dimensional object on the basis of the division number, thereby realizing correspondence to an image of plural kinds of multi-screen construction.

While in the image display device according to the

eleventh embodiment, a description was given of one in which the planes of the three-dimensional object are disposed in a circle in ~~figure 27~~figures 27(a) to 27(d), this should not be considered as restrictive, and it is also possible to dispose them with shifting those in a depth direction or the like.

Further, while according to the image display device in the eleventh embodiment, the parameter information is generated automatically in the parameter generating means 1401 based on the area number information outputted by the image analyzing means 1402, this should not be considered as restrictive, and the configuration may be such that the parameter information and the area cut-out information are multiplexed in the input signal, so as to be inputted to the image receiving means 1101 to be separated therein.

(Embodiment 12)

Figure 28 is a block diagram illustrating the configuration of an image display device according to a twelfth embodiment of the present invention.

In figure 28, the same reference numerals as those shown in figure 18 denotes the same or corresponding parts. Numeral 1508 denotes an image receiving means 1 which receives a first input signal transmitted via broadcast or a network, and outputs a first input image signal comprising a prescribed number of partial images, and numeral 1502 denotes an image receiving means 2 which selectively receives a second input

signal transmitted via broadcast or a network, and outputs a second input image signal. Numeral 1511 denotes an enlargement /deformation means which subjects partial image signals outputted from the memory input/output control means 1103 to enlargement/deformation processing, and outputs an enlarged or deformed partial image signal, and numeral 1505 denotes an image switching means which switches three-dimensional output image signal outputted from the frame memory means and the enlarged-deformed partial image signal outputted from the enlargement/deformation means 1511 at a prescribed timing, and outputs output image signal.

Next, the operation of the image display device according to the twelfth embodiment will be described. The image display device according to the twelfth embodiment performs switching of an image display smoothly, while switching to a full-screen display of the selected channel.

The image display device according to the twelfth embodiment is the same as the ninth embodiment except for the operation of the configuration in which the image receiving means 1101 is replaced with the image receiving means 1 (1508) and the image receiving device 2 (1502), and the enlargement/deformation means 1511 and the image switching means 1505 are added, and only the elements different from the ninth embodiment will be described.

First, the image receiving means 1 (1508) receives the

input signal 1 as a multi-screen image signal comprising plural partial images, and outputs the input image signal 1 to the memory input/output control means 1103. The input image signal 1 is employed for generating an image of three-dimensional display as in the ninth embodiment. On the other hand, the image receiving means 2 (1502) receives the input signal 2 based on the channel information 1218 outputted by the channel deciding means 1111, and outputs the input image signal 2 to the image display means 1109. The input image signal 2 is for full-screen display of a selected channel. Further, enlargement/deformation means 1511 makes the partial image signal outputted from the memory input/output control means 1103 subjected prescribed image effect processing such as enlarging and deforming, and outputs this to the image switching means 1505 as the enlarged or deformed partial image signal. The image switching means 1505 switches the three-dimensional output image signal outputted from the frame memory means 1108 and the enlarged or deformed partial image signal outputted from the enlargement/deformation means 1511, and outputs the output image signal to the image displaying means 1109.

The image displaying means 1109 performs displaying with switching the output image signal and the input image signal 2.

In the twelfth embodiment, the enlargement/deformation means 1511 is added, thereby to perform ~~changing smoothly~~a

smooth change of the image switching method between the three-dimensional screen display for channel selection and the full-screen display of the selected channel, as compared with ninth to eleventh embodiments. Here, a schematic diagram exemplifying an image switching method according to the ninth to eleventh embodiments is shown in figure 29 while a schematic diagram exemplifying an image switching method according to the twelfth embodiment is shown in figure 30, so as to clarify the difference.

Referring to figure 29, numeral 219 denotes the input image signal in case of four division multi-screen, and the three-dimensional object corresponding to four partial images are disposed in a circle to be rotated so as to realize a three-dimensional animation. Numeral 220 denotes an image of the three-dimensional object projected on a display, and numeral 221 denotes an image of a selected channel. In figure 29, an image displayed is instantly changed from a three-dimensional display to an image of circle 1 in concurrence with the selection of channel circle 1.

Referring to figure 30, numeral 224 denotes the input image signal which indicates that an image of circle 1 is selected from the input image signal 222, and numerals 225 and 226 denote the input image signals in which the partial image of selected circle 1 is subjected to enlargement/deformation processing. Other configurations which are the same as those

shown in figure 29 are denoted by the same references and their descriptions will be omitted. In figure 30, when a channel is selected (circle 1 in the figure), the partial image corresponding to circle 1 selected in step S3 is utilized, and displayed with being subjected to enlargement/deformation processing, and it is switched to a full-screen image of circle 1 smoothly after passage of a prescribed time in step S4.

As described above, when switching to a full-screen display of a selected channel, the image display device according to the twelfth embodiment makes the partial image which is employed as a texture during the three-dimensional display subjected to enlargement/deformation processing and then it is displayed by a full-screen display, thereby a smooth image switching is realized.

Further, though the parameter information is separated into the area cut-out information and the three-dimensional coordinate information in the parameter separating means 1102 according to the image display device in the twelfth embodiment, this should not be considered as restrictive and the configuration may be such that the parameter information and the area cut-out information are multiplexed in the input signal 1, so as to be inputted to the image receiving means 1 (1508) and be separated therein.

(Embodiment 13)

Figure 31 is a block diagram illustrating the

configuration of an channel selection device according to a thirteenth embodiment of the present invention.

In figure 31, the same reference numerals as those shown in figures 1 and 18 denote the same or corresponding parts. Numeral 145 denotes a selection input means to which a selection input by a user to select a channel is inputted, numeral 146 denotes a selection plane judging means which judges which of the respective planes composing the three-dimensional rotation body object faces front on a display screen, when the selection signal is inputted from the selection input means 145, and numeral 147 denotes a correspondence table holding means which holds information indicating a correspondence relationship between plural planes composing the three-dimensional rotation body object, texture information of partial images corresponding to respective channels, and area cut-out information for generating partial images corresponding to respective channels based on area information parameter inputted externally, and figure 32 is a diagram exemplifying a correspondence table held by the correspondence table holding means 147. Numeral 148 denotes a channel deciding means which judges a channel that corresponds to a plane judged by the selection plane judging means 146 based on the information held in the correspondence table holding means 147, decides a channel to switch to and display, and outputs selection channel information to an image receiving

means 150, numeral 150 denotes an image receiving means which receives an input signal transmitted via broadcast or a network, selects a channel based on the selection channel information outputted from the channel deciding means 148, and outputs an input image signal, numeral 152 denotes a memory means which holds the input image signal, and numeral 151 denotes a memory input/output control means which writes the input image signal into the memory means 152, outputs a memory control signal to the memory means 152 on the basis of the area cut-out information inputted from the correspondence table holding means 147, and reads a partial image signal from the memory means 152.

The channel selection device according to the thirteenth embodiment maps input signals transmitted via broadcast or a network to respective planes of the three-dimensional rotation body object disposed in the three-dimensional virtual space, and when a prescribed operation by a user is performed, displays channel information corresponding to a plane which faces front the most with respect to a view point of the user.

When the input signal transmitted via broadcast or a network is inputted to the image receiving means 150, the input image signal is outputted to the memory input/output control means 151 from the image receiving means 150. Based on a cut-out coordinate of the area cut-out information, the memory input/output control means 151 outputs the memory control

signal to the memory means 152, extracts the partial image signal from the input image signal held in the memory means 152, and outputs the partial image signal to the texture holding means 149.

In the channel selection device according to the thirteenth embodiment, when a channel selecting operation mode is started, an initial coordinate of the three-dimensional rotation body object in the three-dimensional virtual space, which is held in the three-dimensional model coordinate holding means 104, is read, and the perspective transformation means 106 performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing the initial coordinate and a view coordinate, and outputs a coordinate of a projection plane. The hidden-plane processing means 107 reads the projection plane coordinate from the perspective transformation means 106, removes an area hidden and not displayed, and extracts only an area displayed to output depth information and raster information after hidden-plane processed. The texture mapping means 110 maps the texture read from the texture holding means 149 to the raster information after hidden-plane processed the depth information of which is considered by the hidden-plane processing means 107, on the basis of the depth information held by the depth information holding means 108. Here, the correspondence relationship

between respective planes of the three-dimensional rotation body object and the textures is obtained by reading the correspondence information (plane-to-texture correspondence information) from the correspondence table holding means 147. The rendering means 111 draws all the pixel information such as colors or brightness of respective pixels to frame information after texture mapped outputted by the texture mapping means 110, on the basis of the depth information held by the depth information holding means 108. The frame information drawn by the rendering means 111 is held in the frame buffer 112, and the screen displaying means 113 reads the frame information held in the frame buffer 112 at a prescribed timing to perform a screen display. Thereby, a screen in the initial state of the channel ~~selectio~~ selection operation mode is displayed.

When a user inputs the rotation instruction control signal from the rotation instruction input means 101 in a state where a screen of the initial state is displayed, the parameter changing means 103 reads the parameter before changed (here, parameter in the initial state) from the parameter holding means 102, changes the parameter to record into the parameter holding means 102 as a parameter after being changed, and outputs the counter control signal to the counter means 114, on the basis of the rotation instruction control signal from the rotation instruction input means 101. The coordinate transformation means 105 reads the parameter after being

changed recorded in the parameter holding means 102 and outputs the model coordinate after being changed, which is obtained by transforming the coordinate of the initial coordinate read from the three-dimensional model coordinate holding means 104 with employing the parameter after being changed, to the perspective transformation means 106. The perspective transformation means 106 performs perspective transformation of the three-dimensional virtual space including the three-dimensional rotation body object to a display screen, employing this model coordinate after being changed and the view coordinate, and outputs the coordinate of a projection plane. Thereafter, the hidden-plane processing means 107, the texture mapping means 110, the rendering means 111, the frame buffer means 112, and the screen displaying means 113 perform the same operation as that at the initial display operation of the above-described program selection operation mode, so as to display a screen after the rotation instruction control signal is inputted. For example, in one in which the three-dimensional rotation body object has the shape shown in figure 2, when the rotation instruction control signal in a positive direction is inputted, an image in which plane 1 faces front in the initial state is rotated in a direction of the arrow shown in figure 2 so that an image in which plane 2 faces front is displayed, while it is rotated in an inverse direction of the arrow shown in ~~figure 2~~figures 2(a) and 2(b) so that an image in which plane 6 faces

front is displayed, when the rotation instruction control signal in a negative direction is inputted.

With respect to the rotation instruction input means 101, the operation of a cursor key of a remote control or a keyboard, or the motion of a mouse may correspond to the rotation of the three-dimensional rotation body object as in the first embodiment.

At the rotation instruction control signal inputting operation, a counting operation is performed in the counter means 114 by the counter control signal outputted by the parameter transformation means 103. Specifically, for example, when the rotation instruction control signal in the positive direction is inputted from the rotation instruction input means 101, the parameter transformation means 103 outputs the counter control signal for performing 1-increment of a counter value of the counter means 114, while when the rotation instruction control means in the negative direction is inputted from the rotation instruction input means 101, the parameter transformation means 103 outputs the counter control signal for performing 1-decrement of the counter value of the counter means 114, and the counter means 104 receives this counter control signal and changes its counter value.

When a user inputs the selection control signal from the selection input means 115 in a state where a plane which displays the channel which is desired to be processed faces

front, the selection plane judging means 146 obtains the counting value at that timing from the counter means 114 as the counting information, judges the plane which faces front when the selection control signal is inputted based on the counting information, and outputs the plane as the selection plane information.

The channel deciding means 148 obtains the selection plane information from the selection plane judging means 146, refers to the plane-to-channel correspondence information which is held in the correspondence table holding means 147, and outputs the channel corresponding to the plane indicated by the selection plane information to the image receiving means 150 as the selection channel information.

The image receiving means 150 switches a receiving channel based on the selection channel information and displays the input image signal on the screen displaying means 113.

That is, while the three-dimensional rotation body object displayed on the screen displaying device 113 shows the rotation body object shown in ~~figure 2~~figures 2(a) and 2(b), the texture information for selecting a channel that corresponds to respective planes are displayed according to figure 32. For example, on the basis of the information required for three-dimensional display shown in figure 33, data of channel A displayed for plane 1 constitutes the three-dimensional rotation body object based on apex coordinates of

the area cut-out coordinate A along division boundaries of partial image A.

As described above, the channel selection device according to the thirteenth embodiment is configured so that it cuts out the partial image signal from the input signal transmitted via broadcast or a network, maps these to respective planes of the three-dimensional rotation body object, disposes the three-dimensional rotation body object in the three-dimensional virtual space to perform a display, rotates the three-dimensional rotation body object by an instruction through a prescribed operation by a user, judges a plane ~~wich~~ which faces front the most with respect to a view point of the user when a prescribed selecting operation by the user is performed, and selects a channel that corresponds to the plane with reference to the correspondence table, to display a corresponding program on a screen. Therefore, by employing the three-dimensional rotation body object in the three-dimensional virtual space, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar to a user.

Further, while the input signal of broadcast or the like is inputted to the image receiving device 150 in the channel selection device according to the thirteenth embodiment, this should not be considered as restrictive, and the configuration

may be such that when the area information parameter inputted to the correspondence table holding means 147 is inputted with multiplexed in the input signal, a parameter separating means is provided to separate the input signal and the area information parameter, so that the input signal is inputted to the image receiving means 150 while the area information parameter is inputted to the correspondence table holding means 147.

APPLICABILITY IN INDUSTRY

As described above, a program selection and execution device, a data selection and execution device, as well as an image display device, and a channel selection device according to the present invention can constitute the three-dimensional rotation body object which rotates in the three-dimensional virtual space, while a selection display screen is so far displayed two dimensionally. Therefore, an image of rolling a cylindrical rotation body in the actual world can be made associated, and thereby, it is possible to realize an intuitive operation environment which is familiar to a user.

ABSTRACT

A program selection and execution device, a data selection and execution device, and an image display device ~~according to the present invention~~ displays a selecting object on a screen, wherein textures constituted by still pictures or moving images that indicate contents of objects to be selected are mapped to respective planes of a cylindrical three-dimensional rotation body object disposed in a three-dimensional virtual space, rotates the selecting object by means of a rotation instruction operation by a user, judges a plane turned forward most to a view of the user when the user performs a prescribed selecting instruction, thereby to select an object to be selected that corresponds to the plane.

———With this configuration, there is no need to reduce each plane on the basis of the number of the objects to be selected, resulting in an enhancement in visibility, and an intuitive operation environment which reminds a user of an image of rotation of a cylindrical rotation body can be provided.